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Papers relating to Irrigation in Bengal and the Maghasani Hills

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PLAN SHEWING SITE OF IRRIGATION WORKS ON RIGHT BANK OF DAMOODAH RIVER

Scale 2 Bt. Miles to an Inch.

Note D. represents site of large dam across the River Damoodah.
1.2.3.4. Figures denoting sites of small dams in shallis for diversion of Water.
The blue dotted lines approximately represents the positions of Irrigated Ground.

(Sd) Wm. Smith. C.E.
Executive Engineer
Burdwan Division

Road from Bancoorah
Howrah
Rajbullhaut
Chowkeepore
Bunsee Khall
Damoodah Khall
RIVER DAMOODAH
Chingreeah
Mookerjeeapore
Chandeekhaut
Mangie
Jeypore
Mr Grand Trunk
Jamboo
AMPTAH
RIVER DOMOHANEE
Road from Midnapore
Calcutta
Onlapurrah
RIVER HOOGLY

SELECTIONS

FROM

THE RECORDS

109958

OF THE

GOVERNMENT OF BENGAL.

N°. XXXVI. PARTS I. & II

PAPERS

RELATING TO

IRRIGATION IN BENGAL,

AND

THE MAGHASSANI HILLS,

AS A SANATARIUM.

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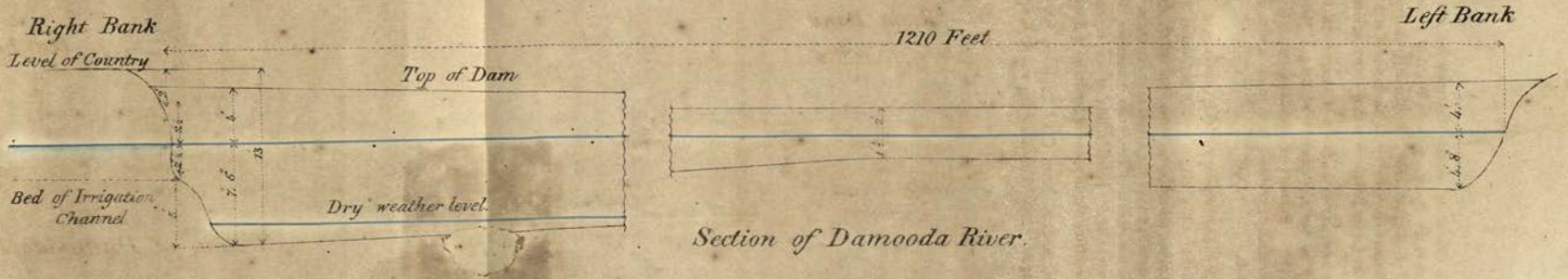


Section of Damooda River.

PAPERS

RELATING TO

IRRIGATION WORKS.

No. I.

From Captain C. B. YOUNG, Officiating Chief Engineer, Lower Provinces, to the Secretary to the Government of Bengal,—(No. 1469, dated the 23rd June 1858.)

SIR,—HIS Honor the Lieutenant-Governor of Bengal will, I believe, read with much interest the accompanying account of irrigation obtained during the dry season from the Damoodah rivers, which is reported by the Executive Engineer of the Burdwan Division, Mr. W. Smith, Civil Engineer, and the Superintendent of Embankments, in his letter, No. 10, dated 30th April 1858, and which I will endeavour to elucidate in some of its principal points by reference to the accompanying diagram.

2. At Rajbulghat, just below where the Bancoorah and Calcutta road crosses the Damoodah, the section of that river is as shewn in accompanying sketch. Its dry weather discharge, flowing at a rate of about $1\frac{1}{2}$ miles per hour, is about 750 cubic feet per second.

3. Here a bund was thrown across the river from bank to bank 1210 feet in length, and of an average height of about 8 feet, consisting chiefly of sand taken from the river bed, but mixed in some places with alluvial earth and also strengthened in those parts, where strength was most required, by many bundles of straw and by bamboos driven into the ground. The total cost of this was Rs. 2,000.

4. The top of the bund was irregular in both its height and breadth. Under the right bank, where the deepest water of $7\frac{1}{2}$ feet

was, after bunding, it was 12 feet high. Under the left bank, where there was another water channel 4' 8" deep, it was 9' high, and in the centre, where there was a sandbank, dry under ordinary circumstances, it was 4 feet. When the water was at its full height above the dam, on the up stream side, the bund topped the water level by 4 feet at both ends and 2 feet in the middle.

5. At the right bank again, where the chief pressure of water was, the dam was made 15 feet thick, at the left bank 10, and in the middle 8 feet broad.

6. Just above this dam, on the right bank, was the irrigation channel or outlet which it was desired to supply with water. This is a natural channel of the Damoodah, of considerable dimensions, filled during floods. Its bed had been deepened by cutting at the mouth to assist the entrance of the water, and was thus reduced to 5 feet above the bed of the Damoodah itself; and the water in that river, having at the same time been raised by the dam from 2 feet to a height or depth of $7\frac{1}{2}$ feet, it followed, that a stream of water $2\frac{1}{2}$ feet in depth, was thrown into the side channel for irrigation purposes. The surface of this water was $5\frac{1}{2}$ feet below the level of the country, and as before stated, 4 feet below the top of the dam.

7. The width of the irrigation channel was about 200 feet, depth $2\frac{1}{2}$. The velocity of the water in it about 1·5 feet per second. Its discharge therefore 750 feet per second.

8. This amount of water was found to irrigate 17,500 beegahs, or say 6,000 acres, thus giving about 8 acres to the cubic foot of water discharged—a far lower amount than that usually taken by canal authorities, which is as much as 120 to 200 acres to the cubic foot in the North Western Provinces. The water was not however, of course, run on to the lands. Being some distance below the surface, it had to be baled up wherever required by manual labor.

9. There was very little leakage in the dam, and no accidents are reported to have occurred to it. Its cost was Rs. 2,000 as before stated. The revenue return has been calculated at 3 per beegah of rice cultivation, or Rs. 52,500 gain to the Zemindar.

10. According to the data derived from irrigation in the North Western Provinces, such a supply of water might be expected to irrigate, at 120 acres of mixed cultivation to the cubic foot, 90,000 acres, or if rice cultivation, 30,000 acres; the water-rate at 1 Rupee per acre would be equal to Rupees 90,000.

11. Where the land is under the permanent settlement, this is all the benefit I imagine which could accrue to Government, and it is liable to deductions for increased cost of building more substantially, costs of establishment, &c., still the work, there can be little doubt, would be remunerative.

12. As it is almost certain that there must be other places in Bengal where similar operations might be conducted with a like satisfactory result, I propose to print and circulate to the Department, the account of the present case of irrigation, and to call upon Officers to institute enquiries throughout their districts, whether there are any places where the relative state of the country and of the rivers flowing through it, are such as to justify the expectation that success would result from endeavors to bring the dry-weather stream of water to the surface, and employ it in irrigation without detriment to adjoining towns or districts.

13. It might be as well if Collectors of districts were, in like manner, called upon to assist the Executive Engineers. It would then perhaps be possible to try the experiment next season in other places and on other rivers than the Damoodah, to bring into utility waters which now run to waste, and to increase the class of remunerative Public Works in Bengal which is at present very small.

From Captain W. D. SHORT, Officiating Superintendent of Embankments, Lower Provinces, to the Chief Engineer, Lower Provinces,—(No. X. dated, Calcutta, the 30th April 1858.)

SIR,—I HAVE the honor to submit for your information and that of His Honor the Lieutenant Governor, a copy of Mr. Smith's report upon the operations lately carried out with such complete success in

damming the Damoodah river, and irrigating a very extensive tract of country situated between the Damoodah and Roopnarain rivers.

2. Mr. Smith here admits (what I have stated in my letter, No. B, of 20th April 1858, to be the case), that the country on the right bank of the Damoodah (where the protective works have been demolished), is so inundated by the flood season (or during 4 or 5 months), that there are no crops, and that during the remainder of the year they derive, wherever water may be available, a scanty subsistence from spring crops. Mr. Smith refers to the map to show how admirably the tract on the right bank of the Damoodah is adapted by nature for irrigation, and I would invite your attention and that of His Honor the Lieutenant-Governor to the map, to prove how admirably most of the districts within this Superintendency are adapted to enjoy similar benefits, and how readily these might be conceded and at the same time a remunerative water-rate assessed, if the Governor would permit such a system to be developed, as it already partially is, in the Midnapore Division. We should then see the country between February and June a sheet of green, instead of as now, dried up.

3. Having myself in 1854-55, executed a dam of sand, protected with matting, bamboos, straw, &c. across the low water current of the Mohanuddy river at Cuttack to divert the current into another channel (through sand,) previously opened to receive it, (a work which enjoyed during progress infinite ridicule,) I gave with much pleasure my approval to Mr. Grose's proposal, and am not therefore surprised that when money was provided, the dam was executed in the Damoodah, (the cause of last year's failure having been explained in my predecessor's letter, No. 0, of 6th March 1857,) and it is only another instance of what would be the result if the districts were dotted over with many individuals possessing Mr Grose's energy, clear-sightedness and means.

Para. 31st.

4. I deem it very important to point out the great advantage derived by the cultivators in having the intelligent European as land-owner. There Mr. Grose, after paying his expences and receiving a handsome profit, enabled 13 village lands, containing 15,000 beegahs, to be irrigated *gratis*, whereby an unexpected accession of 45,000 Rupees

was given to those who had suffered much, not to mention the blessing of fresh water in the tanks for the people and cattle, whereas had a Native land-owner even attempted the experiment of damming the Damoodah, he certainly would have considered it most painful and unbusiness-like to benefit his fellow creatures by a free gift of 45,000 Rupees. In viewing these districts in their present state, and knowing full well what might and should be made of them, one cannot fail to compare such to the difference between a wretched Bengalee and a fine English cow, the former a starved object, providing barely sufficient milk for one child in the family, whilst the latter not only amply supports a large family, but gives a large balance to be sold to meet the taxes and buy luxuries with a margin for charity.

From W. SMITH, Esq., C. E., Executive Engineer, Burdwan Division, to the Officiating Superintendent of Embankments,—(No. 239, of 1857-58, dated Burdwan, the 15th April 1858.)

SIR,—REFERRING to the correspondence marginally noted, relative to the irrigation works undertaken this season by Mr. C. Grose on the right bank of the Damoodah, I have now the honor to furnish the following report, accompanied by a traced map of the locality, and a list of the village lands benefited by these operations.

Embankments.
Executive Engineer's No. 214, of 3rd March, 1858.
Superintendent of Embankments reply, No. 3211, of 8th March, 1858.

2. Mr. C. Grose has lately got possession of the Talook of Joypore, situated between the rivers Damoodah and Roopnarain, due west of Amptah, and part of the estate of the Maharajah of Burdwan. The flooded state of the country between these rivers prevents the cultivation of rice during the rains, and it is only from the spring crops (called by the natives Borodhan) that the inhabitants derive a scanty subsistence. A supply of water is indispensable for the crop, but this cannot easily be obtained at the period of cultivation. The Damoodah, at this time of the year subsides to a comparatively insignificant stream, a few hundred feet wide, and flowing knee deep in a channel several feet below the bed of any of the tributary khals which, during the rains, assist in discharging its flood-waters.

3. One of the most important of these auxiliaries is the Damoodah khal, which leaves the Damoodah opposite Raujbulhaut, and flows parallel to, and at a short distance from the river on the right bank returning to it again at a point above Amptah. Numerous small khals branch from this in every direction, and as the general inclination of the country is westward towards the Roopnarain, a glance at the map will show how admirably this district is adapted by nature for irrigation, provided the surface of the Damoodah can be raised to such a level in the dry season, as will enable its stream to run over the comparatively elevated bed of the mouth of the Damoodah khal.

I have thought it necessary to mention these general features of the district, as it will help any one not personally acquainted with the locality, to obtain a better idea of the irrigation works which form the subject of this report.

4. Mr. Grose commenced operations in the latter end of January last, by forming a dam across the Damoodah, at the spot marked D on map, a short distance below the mouth of the Damoodah khal. The breadth of the river at this point is 1210 feet; its bed shoals in the centre with a channel close to each bank, that near the right bank being 3 feet deeper than the other. The bed of the river is composed of sand, and of this material the dam was made with a small mixture of alluvial earth called pully, in the part near right bank, supported in two places by bamboos and bundles of straw.

This dam took six weeks to construct, and was finished on 7th March, at a cost of Rupees 2,000. When I saw it on 3rd instant, I was greatly surprised at finding such a barrier sufficient to divert the course of the water. The bed of river below the dam was dry, (except some pools of water scattered here and there), scarcely any leakage proceeded from the dam, and this was so trifling that at Amptah, several miles lower down, a streamlet 12 feet wide and 3 inches deep, represented the entire leakage.

The dam ran straight across the river; its crest near left bank was 10 feet wide, diminishing to 8 feet in centre of river, and thence swelling out to a breadth of 15 feet near the right bank. Its height

was not uniform owing to the configuration of the river bed near the left bank, it was 9 feet high decreasing towards centre, where it was not more than 4 feet, and again increasing to a height of 12 feet near the right bank. The crest of dam was generally from 4 to 4½ feet over the water's surface, except at the centre where it was not more than 2 feet, but here the water was only 18 inches deep. There was no attempt made to give a regular slope to the sides of the dam, which stood roughly at an inclination of 2 to 1, and were unprotected except at the rear slope near the right bank where the channel was deepest; and here in two places a row of bamboos had been formed to support a large quantity of straw bundles (about Rupees 3,000 worth,) which formed the base of the dam, and enabled the workmen to close it at a distance of about 4,000 feet from the right bank where a moderate depth of water existed.

5. At the time of inspection the depth of water pressing against the dam was 4-8 near left bank, 1½ feet in centre of river, and 7-6 near right bank. Its surface had however been 2 feet higher some short time before, as could be distinctly seen by the water marks. This rise had been occasioned by a small fresh in the river.

6. When the dam was closed the river rose gradually for 36 hours and commenced flowing into the Damoodah khal, the bed of which had been deepened 5 feet for a short distance at its mouth by a narrow cut. At the period of my inspection the greatest depth of water in the khal was 2½ feet with a sluggish stream about 200 feet wide. The bed of khal was 5 feet higher than that of the river Damoodah.

7. In addition to the large dam just described, a small one marked No. 1 was made near Rogonathpore to prevent the water getting back into the river; another marked No. 2 was made at Duryhanna to prevent its getting into the Dalkissore river; and another marked No. 3 was placed across the mouth of a small khal further south, leading in the same direction. These had the effect of diverting the water to Mr. Grose's lands at Joypore, and after a fortnight's supply to this locality had been obtained, permission was given to the Zemin-

dars to form a dam, marked No. 4, across the khal below the mouth of the Dhalooa khal into which the water was then turned, and passing to the westward afforded irrigation to the lands of thirty villages specified in accompanying list.

After ten days' supply had been given in this direction, No. 4 dam was cut and the water was once more turned in the direction of Joypore.

8. Finding that a sufficient supply had been given in both directions, I ordered the large dam in the Damoodah to be cut on the afternoon of 7th instant, previously sending notice to Amptah to prevent accidents; this was accordingly done, and next morning the pent up water above the dam had fallen two feet. The total cost of these irrigation dams was Rs. 2,300, of which, as already stated Rs. 2,000 had been expended on the large dam across the Damoodah. In an Engineering point of view nothing could be more successful than these operations.

9. The results which followed these operations were equally successful. Mr. Grose secured water for the irrigation of 2,500, beegahs in his own talook, without which cultivation would have been next to impossible; and valuing the rice crop at the moderate rate of Rs. 3 per Beegah, his return is above Rs. 7,500, which will cover all expenses and leave a handsome margin for profit.

10. But in addition to Mr. Grose's land, an area of 15,000 beegahs, in thirty villages, (specified in list) received irrigation for a similar crop by means of these works, and adopting the same valuation as in his case, the value of the crop will amount to Rs. 45,000. It is not over-estimating the advantages afforded by the irrigation to state, that had it not been supplied, the crop would not be worth more than one-eighth its present value.

11. The foregoing information relative to these crops was furnished by Mr. Grose's Gomastha, a very intelligent and experienced man, but deeming the subject of too much importance to rest upon the single testimony of any person, however intelligent, I made the Overseer

of the embankments despatch a trustworthy subordinate into the district to ascertain the truth of these statements and his report, accompanied by list of the several villages irrigated, to which the signatures of the Munduls are attached, fully corroborate the truth of the Gomastha's statement.

12. To sum up briefly, Mr. Grose, at a cost of Rs 2,300 in six weeks' time, made a dam across the Damoodah nearly quarter of a mile long, by which he successfully turned the whole of its water into another channel, from which, by a few smaller dams, he directed the water to the required purposes, affording irrigation to 17,500 beegahs of rice cultivation, moderately valued at Rs. 52,500, in a locality sadly in need of such assistance, and at a time when a threatened famine impends. To which must be added the inestimable blessing of a month's supply of pure water at the most trying period of the year, nor have the advantages been conferred by exacting any sacrifices from the villagers. Immediately bordering the Damoodah below the dam, owing to inequalities in its bed, large pools of water remained sufficient for their use during the diversion of the river, and no complaint whatever reached me of any injury from this cause; neither in my humble opinion does it lessen the value of the operation to know that a landholder, without any assistance from Government further than the necessary sanction required by law, can be found sufficiently energetic and self-reliant to undertake irrigation works of such magnitude at his own expense.

Statement of Villages of the several Talookdars that have been watered in March 1858.

No. of Villages.	Name of Villages.	Area of Land.
		Beegahs.
1	Mausree	500
2	Chund Chuck	400
3	Obheerampore	200
4	Kissore Chuck	300
5	Sona Chuck	200
6	Duckhee Mausree	100
7	Chingra	500
8	Chubbispore	200
9	Par Chubbispore	200
10	Sona Oudah	400
11	Oroondah	1,000
12	Magree	1,000
13	Kuttassa	500
14	Mustabapore	400
15	Pumrashpy	300
16	Dowlut Chuck	500
17	Hurrish Chuck	1,100
18	Mougrah	400
19	Soosan Chuck	1,000
20	Sonapottah	1,000
21	Bhattra	1,000
22	Solebaggah	800
23	Saorah	600
24	Jhamtah	200
25	Roghonathpore	400
26	Bollye Chuck	400
27	Aukha	400
28	Rakhal Chuck	500
29	Ballichuck	300
30	Norendropore	400
	Total, ...	15,200

Burdwan,
The 15th April 1858.

(Signed) Wm. Smith, *C. E.*,
Executive Engineer, Burdwan Division.

No. II.

From A. R. YOUNG, Esq., Secretary to the Government of Bengal, to the Officiating Chief Engineer, Lower Provinces,—[No. 2097, dated the 8th July 1858.]

SIR,—I AM directed to acknowledge the receipt of your letter No. 1469, dated 23rd instant, giving cover to a sketch and a copy of reports by the Officiating Superintendent of Embankments, and the Executive Engineer of the Burdwan Division respectively, describing the successful results of certain operations undertaken during the past season, at his own expense, by a land-holder, Mr. C. Grose, for the irrigation of a tract of country situated between the Rivers Damoodah and Roopnarain.

2. The Lieutenant-Governor has perused with much interest the account given of those Works and of their effects, and so complete a success as appears to have attended this experiment will, no doubt, encourage others to try it, and Mr. Grose's operations may ultimately prove of much importance in connection with the subject of irrigation in general.

3. His Honor approves of your proposal to print the papers under acknowledgment, and to circulate them to the Officers of your department, with a view to the institution of local enquiries as to the advisability of carrying out similar measures in other places; instructions will be issued to the Revenue authorities to afford their aid and co-operation on receipt from you of the printed papers.

4. The plan which accompanied your letter is returned herewith.

No. III.

Circular from Captain C. B. YOUNG, Officiating Chief Engineer, Lower Provinces, to the Executive Engineers,—[No. 320, dated Fort William, the 24th June 1858.]

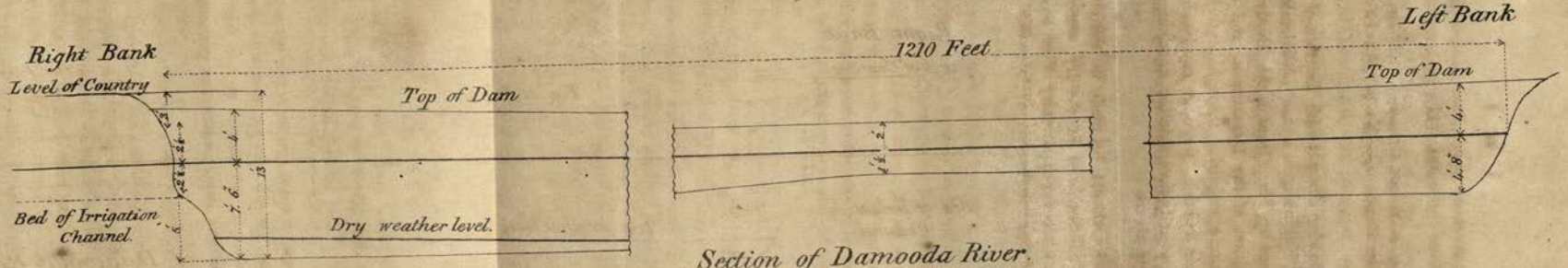
SIR,—THE following abstract with diagram of a report made by Mr. W. Smith Civil Engineer, on a case of irrigation which has been successfully carried out by Mr. Grose in the Burdwan District, is published for the information of the Department, and Executive Officers are requested to institute enquiries throughout their Divisions, and to report whether in their opinion, there are any localities where circumstances appear to be equally favorable for obtaining irrigation from the dry weather streams of rivers.

2. These enquiries should be made in communication with the Civil authorities. The discharge in the dry season of the rivers in their districts should, whenever opportunity offers, be carefully calculated, and the occurrence of any circumstances favorable to the construction of permanent dams, such as natural hill or quarries of stone, should also be reported.

3. The present case has been brought to the notice of Government, to whom it has been suggested to obtain similar reports from the resident District Civil authorities, and to whom any reports that may be received from Executive Engineers will be submitted before the next working season.

4. At Rajbulhat, just below where the Bancoorah and Calcutta road crosses the Damoodah, the section of that river is as shewn in accompanying sketeh. Its dry weather discharge flowing at a rate of about one mile per hour, is about 750 cubic feet per second.

5. Here a bund was thrown across the river from bank to bank, 1210 feet in length, and of an average height of about 8 feet, consisting chiefly of sand taken from the river bed, but mixed



Section of Damooda River.

in some places with alluvial earth, and also strengthened in those parts where strength was most required, by many bundles of straw and by bamboos driven into the ground. The total cost of this was 2,000 Rupees.

6. The top of the bund was irregular in both its height and breadth. Under the right bank, where the deepest water of 7½ feet was after bunding it, was 12 feet high. Under the left bank, where there was another water channel 4′ 8″ deep, it was 9 feet high; and in the centre where there was a sand bank dry under ordinary circumstances, it was 4 feet. When the water was at its full height, above the dam on the up stream side, the bund topped the water level by 4 feet at both ends, and 2 feet in the middle.

7. At the right bank again where the chief pressure of water was, the dam was made 15 feet thick, at the left bank 10, and in the middle 8 feet broad.

8. Just above this dam, on the right bank, was the irrigation channel or outlet, which it was desired to supply with water. This is a natural channel of the Damoodah of considerable dimensions, filled during floods. Its bed had been deepened by cutting at the mouth to assist the entrance of the water, and was thus reduced to 5 feet above the bed of the Damoodah itself; and the water in that river having at the same time been raised by the dam, from about 2 feet to a height or depth of 7½ feet, it followed that a stream of water 2½ feet in depth was thrown into the side channel for irrigation purposes. The surface of this water was 5½ feet below the level of the country, and as before stated 4 feet below the top of the dam.

9. The width of the irrigation channel was about 200 feet; depth 2½. The velocity of the water in it about 1·5 feet per second. Its discharge therefore, 750 feet per second.

10. This amount of water was found to irrigate 17,500 beegahs, or say 6,000 acres, thus giving about 8 acres to the cubic foot of water discharge, a far lower amount than that usually taken by canal authorities, which is as much as 120 to 200 acres to the cubic foot in the North Western Provinces.

11. The water was not, however, of course, run on to the lands; being some distance below the surface, it had to be baled up wherever required.

12. There was very little leakage in the dam and no accidents are reported to have occurred to it. Its cost was Rs. 2,000 as before stated. The Revenue return has been calculated at Rs. 3 per beegah of rice cultivation or Rs. 52,500.

13. According to the data derived from irrigation in the North Western Provinces, the calculated effect and pecuniary value of such a supply of water might be expected to be 750 cubic feet of water per second, which would water (at the rate of 120 acres of mixed cultivation to the cubic foot) 90,000 acres, if of rice, 30,000.

14. The Rent return at one Rupee per acre, would be equal to Rupees 90,000, or if rice cultivation, Rupees 30,000.

15. Where the land Revenue was not permanently settled, there would be a still further and considerable gain to Government from increased revenue.

16. Should circumstances not be favorable to irrigation, it would still form a valuable record, if Executive Officers would estimate and report the discharge, during both dry weather and rains of the rivers in their districts.

No. IV.

From A. R. YOUNG, Esq., Secretary to the Government of Bengal, to the Secretary to the Board of Revenue, Lower Provinces,—(No. 2533, dated the 10th August 1858.)

SIR,—I AM directed by the Lieutenant-Governor to forward for the information of the Board, a copy of a Circular,* No. 320, of the 24th June last, which has been issued by the Officiating Chief Engineer, with the approval of His Honor, in order to the institution of local enquiries by the Officers of his Department, with the object of carrying out in other places similar measures to those which, it will be seen, have been undertaken with successful results, by a land-holder, Mr. C. Grose, for the irrigation of a tract of country situated between the rivers Damoodah and Roopnarain.

* (With 20 spare lithographed copies.)

2. The Lieutenant-Governor requests that the Board will be good enough to forward a copy of the Officiating Chief Engineer's Circular in question to such of their subordinates as are likely to take an interest in the subject, and to call for reports from different parts of the country as to the practicability, in other places, of carrying out similar operations.

No. 2534.

COPY of the above letter forwarded for the information of the Officiating Chief Engineer, Lower Provinces, with reference to his Circular on the subject, and to para. 3 of the Orders No. 2097, of 8th ultimo.

No. V.

From E. T. TREVOR, Esq., Secretary to the Board of Revenue, to the Secretary to the Government of Bengal,—[No. 330, dated the 29th July 1859.]

SIR,—WITH reference to Government Order No. 2533, dated 10th August last, I am directed by the Board of Revenue to submit the accompanying abstract of the reports received from the Commissioners consulted by the Board as to the practicability of carrying out irrigation operations similar to those of Mr. Grose, in the Districts of their Divisions.

2. It appears to the Board that Mr. Grose's scheme, which he successfully carried out, was very similar to the experiment conducted at Captain Beadle's recommendation in 1857, which, partially failed owing to the delay in making the side cut, causing an accumulation of water which undermined and broke the dam. No doubt, the Board remark, the same system of irrigation might be very succesfully adopted by many land-holders; but there are so many jealousies to meet, and so many interests to reconcile, that it is useless to expect any thing on a general scale being done by the native land-holders: indeed, the Board are of opinion that no extensive system of irrigation can be satisfactorily carried out without an irrigation law.

3. There are, doubtless, many places in which operations similar to those of Mr. Grose, might be undertaken with great advantage; but the Board are unable, from want of the necessary information, to recommend any particular localities for experiments of this kind.

Abstract of Returns to the Board's Circular No. 303, *dated the* 23*rd August* 1858.

Patna.—The Commissioner of Patna remarks that the *Behar* District suffers very much from want of water, and much good might be effected by a good system of bunds across the Soane, the Poonpoon, and rivers which cross the Trunk Road, and those which descend from the hills in the Sub-division of Nowada. The whole of the rivers to

the South and East of Behar are mountain torrents; stone is to be had in the upper course of all these rivers in abundance, and if dams were thrown across them at intervals of a few miles along their channels, not only would the country secure the benefit of a perennial supply of water, but the violence of the floods, which now devastate the neighbouring lands and destroy our roads and bridges, would be very much diminished. In *Patna* the Poonpoon is almost the only river which could be dammed up with advantage; if dams were constructed on this river in Behar, the current would be so much diminished in point of velocity that there would be no difficulty in curbing the stream in Patna with common earthen bunds, which the Zemindars would probably throw across the channel with very little encouragement. In *Tirhoot* irrigation is already frequently effected by damming up the nullahs; and a survey of the rivers by competent Officers, coupled with a series of levels taken in different directions across the country, would doubtless shew that the system might be much extended. In *Champarun* a great deal of good might be effected by irrigation, and there exist numerous streams in that district which might be turned to account. Of the interior of *Sarun*, Commissioner has not sufficient experience to speak with certainty; but he has no doubt that great improvements might be effected there also by means of irrigation. On the whole, Commissioner would be glad to see a careful survey of his Division undertaken with a view to the improvement of the existing means of irrigation.

Rajshahye.—The Commissioner of Rajshahye, after communicating with the Collector of his Division, is of opinion on the whole, that measures similar to those undertaken by Mr. Grose could not be successfully carried out in any of the districts of his division, in fact, he remarks, none of the rivers are of the same character as the Damoodah which, being not more than ankle deep in many parts in the dry season, can have no navigation, whereas the rivers in his Division generally admit of navigation, to some extent, throughout the year, which would be an objection to the adoption of the proposed plan; moreover, the means of irrigation are not wanting to any serious extent anywhere in his Division.

Burdwan.—The Commissioner reports that the Collector of *Beerbhoom* is told by Mr. H. Erskine, an experienced planter on the border

of the Adye, that the success of any attempt to irrigate from that river is very doubtful, and he is unable to speak of the Mor. The *Burdwan* Collector thinks much irrigation from the Damoodah feasible, but mentions that the Executive Engineer is of opinion, that any attempt to benefit that district from that river would injure Mr. Grose's irrigation lower down. The Collector of *Hooghly* thinks that irrigation might be successfully resorted to in many places, but he adds that no Collector has at his disposal, the means of forming a really sound opinion in this subject. For the same reason the Commissioner, though he has no doubt in his own mind that irrigation might be adopted to an enormous extent with advantage, could not venture to offer an opinion whether, in any given place, that advantage would be gained without preventing the possibility of similar benefit to other lands; nor is he able to imagine how any fair judgment on this subject can be formed, without a scientific survey of a large tract of country.

Nuddea.—The Commissioner of Nuddea remarks that Mr. Grose's plan might be practicable in the Nuddea rivers, but to dam those rivers would be to stop the navigation.

No. VI.

From E. H. LUSHINGTON, Esq., Officiating Junior Secretary to the Government of Bengal, to the Secretary to the Board of Revenue, Lower Provinces,—[No. 81, dated on Board the Lieutenant Governor's Yacht *Rhotas*, off Bhaugulpore, the 22nd August 1859.]

SIR,—I AM directed by the Lieutenant Governor to acknowledge the receipt of your letter No. 330, of the 29th ultimo, and to request, with reference to the opinion expressed in the 2nd paragraph thereof, that the Board will have the goodness to favor His Honor with the heads of such an irrigation law for the Lower Provinces as they may consider suitable.

No. VII.

From E. T. TREVOR, Esq., Secretary to the Board of Revenue, to the Officiating Secretary to the Government of Bengal,—[No. 5, dated Fort William, the 6th January 1860.]

SIR,—I AM directed to acknowledge the receipt of your letter No. 81, dated 22nd August last, and in reply to submit the following observations:—

2. The present Law, Act VI. of 1857, will enable the Government to take any land that may be necessary for Canals, but it might further, the Board think, be requisite for the purposes of procuring the supply of water to give the Government the power of using and damming up shallow streams and rivers, the beds of which are now considered the property of individuals and used for their profit.

3. The great object however, would be to regulate the levy of Rents for the supply of water and to protect the works from injury, to which, in the Lower Provinces, they would be very liable from the jealousies and interests of parties.

4. For this purpose a law similar to Act VII. of 1845 would be necessary; but with more stringent enactments than those in Sections V. and VI. of that Act, to provide for the protection of the Works and for the punishment of any persons injuring them.

5. An addition will also be required to the latter part of Section IV., and balances should be recoverable from any property of the defaulter by any process in force for the recovery of Revenue *or rent.*

6. When the canals shall have been completed, rules may be drawn up under Section II. of the Act, similar in their nature to those passed by the Lieutenant Governor of the North-Western Provinces, under date 31st May 1845, and published in P. P. 716 et seq. of the *Government Gazette* of that year.

No. VIII.

From A. R. THOMPSON, Esq., Junior Secretary to the Government of Bengal, to the Officiating Chief Engineer, Lower Provinces,—[No. 267, dated the 23rd January 1860.]

SIR,—I AM directed to call attention to the letter from this Office No. 2097, dated the 8th July 1858, and to state, that the Lieutenant Governor will be glad to receive the Reports of Executive Engineers therein referred to, together with any remarks you may have to offer regarding the practicability of employing the streams of rivers during the dry season for irrigation purposes.

No. IX.

Office Memorandum, No. 2394, dated Fort William, 28th August 1860.

WITH reference to Mr. Junior Secretary R. Thompson's No. 267, dated 23rd January 1860, the undersigned has the honor to submit, for the information of the Honorable the Lieutenant Governor of Bengal, the accompanying printed copy of the documents, noted in the margin, on the subject of the practicability of turning to advantage the dry-weather streams of rivers in Bengal.

Officiating Superintending Engineer, Presidency Circle's No. 6844, dated 3rd April 1860.
Superintending Engineer, Burdwan Circle's No. 4455, dated 13th April 1860.
Superintending Engineer Burdwan Circle's No. 4480, dated 16th April 1860.
Superintending Engineer, Behar Circle's No. 5682, dated 17th April 1860.

2. The Reports afford all the information available on the subject at present, and although many of them are full of considerable promise, they are yet not of such a definite nature as to allow of any proceedings being adopted; but it would appear that land-owners in many parts of the Lower Provinces, as, for instance, in the Patna, Burdwan, and Balasore districts, are fully alive to the advantages of irrigation, and that they suit their system to the means available.

3. It is beyond doubt that many opportunities would offer of improving the system of irrigation, either where tanks or reservoirs are used as in Behar, or where dry weather streams are used as in the districts of Midnapore and Orissa; but to admit of this being done, it would be necessary, in the first instance, to obtain additional aid in Engineering Staff; and secondly, for the Legislature to decide the rights of the several parties concerned, to enable Government to recover the expenditure incurred.

4. The undersigned regrets much that he is not prepared at present to submit any general scheme for the consideration of Government, nor would the Officers of the Department be able to carry out in its details, or take up with any hope of doing the justice to it which it merits, so important a subject.

5. Could the funds at the disposal of the Civil Commissioners of Divisions be so increased, by any means, as to enable them to maintain permanently a competent Civil Engineer for the scientific works of their Divisions, works of irrigation might, it is considered, form a very important and remunerative branch of the duties of those Officers. For the Divisions of Patna, Burdwan, Bhaugulpore, and Nuddea, District Civil Engineers have already been sanctioned by Government, but it has been found on enquiry that the funds available are not of that extent to justify the payment of such a salary, *viz.* Rupees five hundred per month, as would secure the services of a really competent Civil Engineer.

Rupees 500.

6. That resources may be increased at a future period there is some hope, and in that case no time should be lost in initiating a trial, which must, in the course of improvement, be established sooner or later, after a few years. It is suggested that over the Divisional or District Engineers should be appointed another or 8th Superintending Engineer, under the Chief Engineer, who would attend to all the local Engineering Works in progress, including of course works of irrigation.

(Signed) C. B. YOUNG, *Lieut. Col.*,
Chief Engineer, Lower Provinces.

From CAPTAIN A. IMPEY, Officiating Superintending Engineer, 1st Circle, Lower Provinces, to the Officiating Chief Engineer, Lower Provinces,—[No. 6844, dated the 3rd April 1860.]

SIR,—IN reply to your No. 7391, dated the 30th March 1860, I have the honor to state, that there are only two Divisions in my Circle to which the Circular* you allude to would now apply, *viz.*, to the Barrackpore Division, and to the Arracan Division.

* No. 320, dated 24th June 1858.

2. The Circular was forwarded, I believe, to all the Divisions lately comprising the late 1st Circle, but no replies were received. If information on the point be still required, it might be applied for through the Superintending Engineers, South-Eastern and Upper Assam Circles.

3. The Barrackpore Executive Engineer replies that he is so little acquainted with the numerous rivers in his Division, excepting at the points where the roads cross them, that he could not give a satisfactory reply to my enquiry. I do not well see how he possibly could give a reply of any value unless he could devote a considerable time to that special object.

4. He mentions, however, that all the streams with which he is acquainted are navigable for small country boats, which would prevent without expensive arrangements being made, their being dammed for irrigation purposes.

5. The Executive Engineer of the Arracan Division, in a letter received this day, writes that all the streams in this Division rise in mountain Districts as torrents; that in their course through the hills there is no land available for irrigation, while immediately after reaching the plains they are tidal, and their waters become brackish and unfit for irrigation purposes.

From CAPTAIN J. P. BEADLE, Superintending Engineer, Burdwan Circle, to the Officiating Chief Engineer, Lower Provinces,—[No. 4455, dated the 13th April 1860.]

SIR—I HAVE the honor, with reference to your No. 6403, dated 9th February 1860, to state that no particular reports have been received from the Executive Engineers of the late 3rd Circle, in accordance with the 1st paragraph of your Circular No. 320, dated 24th June 1858, on the subject of the practicability of employing the dry-weather streams of rivers for irrigation purposes other than those mentioned in the margin.

Burdwan.
Tumlook.

2. Mr. Smith, the Executive Engineer of the Burdwan Division, was most anxious to have the utilising of the dry volume waters of the Damoodah made over to his agency, and he submitted a valuable correspondence with Mr. Grose, the Zemindar, who had previously effected the irrigation which originated your Circular, and made certain propositions on the subject. I personally sought to obtain the sanction of

Government to carry out this operation, but failed in my endeavour to obtain the consent of Government to Mr. Smith's undertaking the work. His Honor, however, sanctioned my moving the Revenue Board officially on the subject, and a copy of my letter No. 3323, of the 11th March 1859, to the Revenue Board, is annexed.

3. This letter made Mr. Smith's correspondence a handle to the general question, and mooted the subject of an enactment to enable Government to sell the waters of the rivers to the Zemindars delivered upon their fields.

4. I have received no reply to this letter.

5. In the year before Mr. Grose's successful work of irrigation, this Department had undertaken the construction of dams in the Selye and Sankra rivers (two branches forming the Roopnarain), and also in the Damoodah at Modeepore, according to the written request of certain Zemindars, and with the consent of the Revenue Board and of Government. The two first dams were constructed by Lieutenant Black, the Executive Engineer of the Culmejole Division, and answered the purposes for which made, but the Damoodah dam failed, and this failure prejudiced the whole matter.

6. Mr. Grose, Talookdar of Joypore, was not deterred by it however, and made his dam succesfully during the subsequent season at the take-off of the Damoodah Khal many miles below Modeepore.

In the following year (1858-59,) when Mr. Smith had been so desirous of making the dam, "a fresh" occurred at the period when the dam would have been under formation, and I believe it stopped Mr. Grose's proceedings, who had commenced the work, but a little late in the season. No irrigation consequently was carried out from the Damoodah in 1859. This year Mr. Grose has made his dam, and I have written to Mr. Smith for the particulars of the Work, of the irrigation, and of the results.

7. Lieutenant Garnault, the Executive Engineer of the Tumlook Division, reports, with reference to Chief Engineer's Circular letter No. 6403, of the 9th February, that "all the dry-weather streams of the

fresh water rivers of the Tumlook Division have been employed for irrigation. The Zemindars have themselves constructed the dams across the different rivers after having made a deposit, and signed an agreement that they would clear them by a certain time."

Lieutenant Garnault adds, " I saw on my late tour a large quantity of land which had been irrigated by the Sankra, Amoodur, and Darkissore* rivers, but cannot at present inform you of the number of beegahs irrigated, nor the profit per beegah.

* These rivers form the Roopnarain. J. P. BEADLE.

8. The Zemindars on the Selye, Cossye and Kaleaghye* rivers always construct dams for the irrigation of the low lands, and I may say that the only river in this Circle (Burdwan) which is not utilised in this way is the Adji river, the dry-weather volume of which is small, and the bed wide and deep with dry sand, besides which it is not subject to a tidal influence.

* Upper and fresh water portion of the Huldee river. J. P. BEADLE.

9. There is always a principle to be observed in such movements, and the principle on which these Zemindary dams are constructed in this Circle is, to separate the fresh water from the salt water, and to heap up the fresh waters just as they reach their lowest point, and where the river has somewhat of a muddy bottom. This secures the irrigation of the lowest lands on which the Burroo dhan or dry-weather rice is cultivated. The river bed has also very little slope in these places, and the bottom being firm, the dams are constructed with some security. They are made during the cold weather, and are removed before the South-west monsoon commences.

10. There have been other dams in this Circle constructed by the Salt Department, for the purpose of arresting the salt tides, and delivering them unmixed upon the salt manufacturing lands. These dams have been made right across the rivers Kaleaghye and Cossye, and standing throughout the salt manufacturing season, they have each year caused the silt to deposit in the beds of the Rivers at their mouths to an extent which has been prejudicial to the discharging powers of the rivers when the first great floods of the South-east monsoon come down,

for these have to sweep out and re-excavate the beds where silted up, and the result of these recurring operations carried on for the last eighty years have tended to raise the beds of the rivers, and to endanger the cultivated lands in time of floods.

11. Last season I obtained the Revenue Board's dictum that the interests of the Salt Department must give way to the agricultural interests of the districts, and as Superintendent of Embankments I have, with their concurrence, put a stop to the practice of the Salt Department damming across the rivers in their tidal reaches.

12. The late Salt Agent of Tumlook considered this a very disadvantageous measure to his Department, and called my attention to the fact of agricultural dams having been constructed by the Zemindars in the Cossye above the site of the salt dam.

13. I have instructed the Executive Engineer of the Midnapore Division, Zemindaree embankments, in the following terms respecting these agricultural dams:—

On the Cossye.

"Dams must not be constructed in the tidal reaches of a river without the consent of the Executive Engineer acting under the Superintending Engineer's orders. That at Kapastickree was so high up that it was not of much importance with respect to the increased deposits in the mouth of the river, but the dam at Gharoi or Kissore Chuck, was in a position that demanded great vigilance, and if allowed at all for the purpose of rearing the cold weather crops, it should have been permitted in such wise that, directly the required supply of fresh water had been secured, the dam was to be removed entirely and completely, and all expenditure connected with its removal, and such excavation of the bed as might be required to be recovered from the Zemindars concerned. The exact place for such a dam should be fixed by the Executive Engineer, who would place it as high up the river as possible with reference to the plains to be irrigated, and the date of removal must also be carefully ordered by him, and the Executive Engineer must see that the order is perfectly and completely carried out.

"3. A limit should be fixed in each river, below which a dam is on no account to be constructed, and a date should be fixed beyond which the continuance of dams in the upper reaches is on no account to be permitted, and on which an inspection is to be made to see that they have not only been destroyed, but entirely removed, and that the bed at the place has been made uniformly deep for the whole section, and to the full depth required by the river at that point, and a report should be filed in the office to this effect.

"4. It must be borne in mind that these agricultural dams are required to be constructed, and should be removed, before the South-west monsoon sets in, and that the effect they have is a very different one to that which the great salt dams have therefore exercised, placed where the tides serve with violence, and maintained throughout the monsoon, and until the rainy season, with its land floods, removes them, and clears the river of their obstructions."

14. I have entered at length on this subject of agricultural dams to show both what the practice of the Zemindars in these districts is, and the present stage of matters regarding the construction of dams just above and within the tidal limits. A great deal of benefit is now done by means of irrigating dams, but the Zemindars only think of their own benefit, and there is no system in the supply of and payment for water.

From CAPTAIN J. P. BEADLE, Superintendent of Embankments, to the Secretary to the Board of Revenue, Lower Provinces,—[No. 3323, dated the 11th March 1859.]

SIR,—HIS Honor the Lieutenant-Governor has sanctioned my moving the Revenue Authorities officially in the matter of the accompanying correspondence between Mr. Smith, the Executive Engineer of the Burdwan Division of embankments, and Mr. Grose, the Talookdar of Joypore.

2. Mr. Grose is the enterprising gentleman who constructed at his own expense, in the early months of 1858, a temporary dam across

the water channel of the Damoodah, where the Damoodah khal takes off, forcing the flow of water down that course, and raising its level till the water spread over the low-lands between the Damoodah and Roopnarain, directed by the embanked channels which intersect that tract, all of which had been closed at the lower ends.

3. His expenditure was under 3,000 Rupees, and the aggregate value of the crop of paddy secured was according to Mr. Grose's estimate, 1,60,000 Rupees, an estimate formed upon the value realized from his own lands and the amount is so large because, the selling prices* were so high at that particular time.

* More than twice the usual prices.

4. The Revenue Board will not have forgotten the attempt made to irrigate this, and other low tracts in the previous year at Modeepore, higher up the Damoodah river, and on the Selye and Darkissore rivers. The plan and places of irrigation were proposed by certain Zemindars, who were to bear eventually the expense of the Works. The Works were to be constructed by the Public Works Department, and the expenditure to be recovered proportionately by an Officer of the Revenue Department, associated for this purpose with the Executive Engineer. The dams on the Selye and Darkissore were accomplished successfully, but that on the Damoodah failed, the Collector having interfered to prevent the bank being cut through, and the work having been suspended just at the time it should have been closed without delay.

Since this letter was written I have conversed with Mr. James Young, the Commissioner, on this subject, and he considered that the Collector's proceedings did not contribute to the failure. That we were not ready, and that the Zemindars themselves were not ready.

I confess that in a case of failure I think the fact is sufficient. It sticks to this department, and we did fail in securing the objects of the measure after we were allowed to proceed, but I was only allowed to cut through the bank, and to connect the river with its old take-off channel, on my accepting the responsibility of closing the cut afterwards, effectively so, that it should not be breached during floods, a grave responsibility undertaken in the desire to do good, which good was not done, but the bank was successfully re-formed.

J. P. BEADLE.

5. It will be seen from the correspondence herewith forwarded, that Mr. Grose asserts a right as Talookdar of Joypore, to construct a dam across the Damoodah at the Damoodah khal, and that he is willing to forego this right, and to pay for the water if Government should con-

struct this dam, but that he objects to the position of Modeepore, as involving greater difficulty, and therefore a less certain success than the locality of the Damoodah khal lower down the river.

6. Mr. Smith, the Executive Engineer of the Damoodah, was most anxious this year to be allowed to construct the dam at the Damoodah khal. He stated that a grant of Rupees 3,000 would suffice; that he would first measure the areas of land to be irrigated, and draw up a contract Deed for each land proprietor, stating the amount to be paid for the water. If this Deed were signed within ten days from the completion of the dam, the rate to be 4 annas per beegah; if after ten days and before twenty days, 8 annas a beegah; and after this period of twenty days, 12 annas per beegah.

7. Mr. Smith was to have supervised the whole of the operation, and the only assistance the Executive Engineer asked for was, that of a qualified subordinate Officer of the Hooghly Collectorate to be attached to him, for the purpose of drawing up the contract Deeds, and of recovering the water-rate.

8. This Damoodah dam should be constructed in January, but notice of its intended construction should be given in November, as the sowings are made in December. The water should continue to flow inland for about a month, after which the dam is cut, and the obstruction thoroughly removed.

9. I examined the locality in November 1858, and found no trace of the previous dam. The bed of the river was of full depth, and more than usually free from sandbanks.

10. I shared in the Executive Engineer's anxious desire to construct the work this year, and took advantage of my proceeding to inspect a portion of the 24-Pergunnahs embankments, to urge the matter personally, at an interview with His Honor the Lieutenant-Governor of Bengal, the result of which led to my directing the Executive Engineer to inform Mr. Grose, that the Government would not this year move in the matter of constructing this temporary work for irrigation.

11. I may add, that Mr. Grose has not himself constructed the dam, and that unless the extraordinary rain-fall we have experienced this month has sufficed for the cultivation, the people on the lower portion of the right bank tract will not have benefited as they did last year. The Fusl rice crop was, however, a good one, superior to any crop they have had for years.

12. It would seem that a law is required for the sale of water delivered at the fields where works have been constructed for the purpos of artificially raising its level and of distributing it.

Mr. Grose had to make a private arrangement with the parties to whom he supplied and sold water. The conditions he made with the land-holders were, that one-fourth the amount was to be paid on the contract being signed, one-fourth when the water commenced to flow up the lands, and the remaining half when the water had been received in full.

The first-fourth was paid freely; the second-fourth was paid at the convenience of the parties; and to the payment of the last half, every one had some objection to make after a period of four months. Mr. Grose it appears closed his account, but with deductions in many cases, so that the total amount for which he had sold the water was considerably reduced, and in his letter of the 22nd September 1858, Mr. Grose writes, that "to me the land-holders and cultivators were beholden for the benefit they derived from the irrigation of their lands, and yet they felt not the smallest hesitation to deprive me of what I had fairly earned from them."

13. On the Selye, Darkissore and Cossye rivers, it is the custom to make similar dams, but there is always more or less difficulty between the land-holders about the expenditure of money and distribution of water. If the operations were systematised, and the dams were constructed annually by the Officers of Government, the land-holders would in all probability pay, with pleasure, a fair rate for the water delivered upon their fields, and it is with a view to this matter being considered by the Revenue authorities that I have the honor of addressing you.

14. The way in which the Zemindars came forward in 1856-57 shows that they feel the want of some authoritative enactment, by which the benefit of all concerned may be secured, without room being given for quarrels and litigation. They saw the advantage also of the superintendence of Government Officers to prevent the waste of water when raised to the required level, and to secure its distribution equally to all who are conveniently situated to receive it, and are willing to pay for it.

15. There is moreover a risk of failure, which is much increased by any vacillation of purpose; and in a large river like the Damoodah, one land-holder does not like taking the double chance of the dam answering, and of recovering from the other land-holders, who will benefit, a fair price for the water he may secure for them.

16. It therefore becomes a question for Government to consider whether it will aid the cultivators on the low-level flat lands which border the rivers in their delta channels, by the regular construction of works which, during the dry season, will secure to these lands a supply of water for a hot-weather crop, the Fusl crop being always more or less uncertain in such places, and by legal enactment to provide for the levy of a fair water-rate, that will make the working of such a system directly remunerative.

17. This would be the commencement of irrigation on a larger and more profitable scale. When land-holders see how certain the cultivation becomes when water can be purchased at the fields, they will desire to have the same advantage on the lands of higher level; and commencing on the low grounds with temporary dams, works of irrigation will extend up the rivers, till the danger of the floods will be materially lessened by the permanent measures adopted to hold back the waters, and to store for irrigational purposes.

18. The Revenue Board will remark the zeal shewn by the Executive Engineer in his desire to secure the advantage of irrigation to the cultivators, and I have hopes that this zeal will ultimately find its reward in the measure being adopted by Government, and placed on a proper footing.

From CAPTAIN J. P. BEADLE, Superintending Engineer, Burdwan Circle, to the Officiating Chief Engineer, Lower Provinces,—[No. 4480, dated the 16th April 1860.]

SIR,—IN continuation of my letter No. 4455, dated 13th instant, and in further reply to your No. 6403, of the 9th February 1860, which refers to a period when the Cuttack Circle formed a portion of the 3rd Circle, and was under my superintendence, I have the honor to state that I have a distinct memory of Mr. Rayner, the Executive Engineer of the Pooree Division, having written at least two communications on the subject of irrigation by dams, one with reference to your Circular of June 1858, the other with advertence to a proposal made by the Collector of Pooree.

2. As I have not the documents in this office, I have forwarded a transcript of your No. 6403, dated 9th February 1860, together with a copy of this letter to Captain Harris, who will take up the question and supply you with more information about the matter than I can do.

3. I may however state that the cultivation in the Balasore Division is assisted greatly by artificial means during the rainy season. There are many isolated embankments scattered throughout the District, which are dams retaining the rain-fall and keeping it on the higher lands, which, without these aids, would drain off the water too rapidly for the growth of crops. If these dams were supplied with sluices, or each with a sluice, the system would be a very good one, but now the dams have to be cut to prevent the crops being drowned, and then the waters run off and the gaps are not effectively closed, and the cultivation becomes precarious instead of tolerably certain. The Works also are not kept in that order which might be looked for if they were completed with sluices, giving the agriculturists a command over the water. There are other portions of embankments also, placed on the low side of a nullah, to throw the waters upon the other side, which is highly cultivated. In fact, throughout Balasore, there are rude but clever attempts to aid agriculture, and to secure crops against the draw-backs of level and climate. I know no district more capable of being im-

proved than Balasore, or where artificial works of irrigation are more called for to assist in rearing the crops. Irrigation is carried on to a limited extent in the lower water-courses of the Byturnee river, but the volume,* although arrested by a dam, does not rise over the bank, and the water has to be raised, which is generally done by spooning it up in a scooped-out trunk worked between uprights.

* The main channel and other branches being open for its escape.

4. There is a temporary cross dam constructed annually in the bed of the Byturnee (the Styx of the Hindoos,) at the place† where the waters are said to descend into the earth; and the pilgrims who assemble in great numbers at this period bathe in the waters, which, however, I believe do not rise‡ to a height that would admit of irrigation by such means alone.

† Between the road and Jajipore.

‡ There is a great take-off above the place leading into the Kursooa deep channel, which, if left open, would prevent any great rise of the water.

5. The most fertile lands, and the best cultivated portion of the Balasore Division, are on the Byturnee and its branches between the road and the salt marshes, and the whole of this land requires water. I should think that temporary dams constructed simultaneously across every outlet, and just at the points up to which the neap tides serve, would, during December, raise the water sufficiently for a general irrigation of the lower lands, and that the same process might be adopted with advantage on the minor rivers in the Bhudruck Sub-division.

Here we see the necessity for such works being undertaken by Government. A river has several branches; any one of these left open would carry off the dry-weather volume, so that to make one dam serviceable, others must be made and in the estates of other land-holders.
(Signed) J. P. Beadle.

6. When last at Pooree, I proposed to the Collector to place similar dams in the narrow channels of the Pooree rivers, so that the flow of the fresh water might be arrested, and the rivers converted, for the time, into reservoirs, advantage being taken of the rise in the waters to irrigate the lands; but the work being done mostly as an experiment to see to what height the waters would rise arrested, in this way, the Collector (Mr. Mactier,) seemed anxious to have the measure carried out, and I mention it now to give myself the opportunity of recording that it is a cheaper, more ready, and more certain way of arriving at the knowledge required to actually make such a dam or series of dams,

than to organize a survey, and to obtain theoretical knowledge from figures and plans. In this particular kind of work, I believe it is best to make the obstruction, and to see what its effects are, and whether the results justify doing the work again next year with all the improvements that experience and observation would enable a careful and practical Engineer to make. The result of such experimental work could not be an entire failure, for every foot that the water is brought nearer the surface of the land would be eagerly taken advantage of by the people, who now laboriously obtain the water by raising, wherever it is possible, with simple appliances to do this and where the soil is worthy of the labor. In Ungool* the agriculturists cultivate with the aid of temporary dams for irrigation, and it appears that temporary dams formed like ropes of sand across the beds of rivers, are made for similar purposes on the Madras side called Courumboos. A description of these Works is given in the 80th and 81st pages of Captain (now Colonel) Arthur Cotton's report on the Colleroon Annicuts, as published in the 1st volume of the Madras Engineer Papers; but the experimental Works I advocate, are not ropes of sand, but sound and firm dams of clay and sand, strengthened with fascines as required, so that the work placed in narrow channels may support a considerable body of water.

* See Mr. Rayner's report on the agricultural arrangements in Ungool—a visit undertaken and report written at the request of Mr. Samuells, when Commissioner and Superintendent of the Tributary Mehals.
(Signed) J. P. Beadle.

7. I believe that a great deal of good might be done in this way, but there are difficulties and there might be failures, and a large discretion, and a very liberal support should be given to an Executive Engineer carrying out experimental temporary works like dams, formed with earth and sand, in the beds of rivers, during the dry season to assist irrigation.

From Major W. Maxwell, Superintending Engineer, Behar Circle, Lower Provinces, to Lieutenant Colonel C. B. Young, Chief Engineer, Lower Provinces,—[No. 5682, dated the 17th April 1860.]

Sir,—With reference to your letter No. 6402, of 9th February last, asking me if any enquiries had been made by the Executive Engineers of the late 2nd Circle, regarding the practicability of employ-

ing the dry-weather streams of rivers for irrigation, I have the honor to submit the following letters from Officers :—

Executive Engineer, Berhampore Division, No. 1360, of 5th March 1860.
Executive Engineer, Dinapore Division, No. 1747, of 13th April 1860.
Executive Engineer, Patna Division, No. 239, of 1st March 1860.
Executive Engineer, Ramghur Division, No. 341, of 1st March 1860.
Executive Engineer, 2nd Division, Grand Trunk Road, No. 350, of 10th April 1860.

2. A copy of your letter No. 6402 was submitted to the six Officers who lately belonged to the 2nd Circle, as well as to the Officers of the four Divisions who now compose the Behar Circle, but as only one has replied to it (*vide* Berhampore Executive Engineer's letter), and he informs me he has submitted his report to the Superintending Engineer of the new Circle, I presume others have done so also. I will therefore confine my observations to the Behar Circle.

3. I am not aware of any streams in Behar or Tirhoot that could be conveniently turned to account for irrigation purposes that are not so used. I am of course referring to petty irrigation schemes; projects such as the Soane one are not within the meaning of your Circular No. 320. In Behar the general irrigation arrangements are very extensive; the rivers that hold water during the dry weather are all made use of; reservoirs to retain the rain are scattered over the face of the country, but apparently, every one who owns a "Khuzana" (reservoir) does what he likes with it, creating unwholesome swamps as he likes and where he likes. If some degree of system could be introduced into this chaos, without interfering with vested rights, a very great good would result to the population of the country, for much of the Behar fever is without a doubt attributable to these artificial nests of malaria.

4. In the Ramghur Division, there are positively no running streams except the Dorundah. I need not refer to any scheme for taking off water from that river. The other streams are hill torrents dry during the cold weather. In Tirhoot, the Chota Gunduck as well as the large Gunduck rivers could no doubt be turned to account in any

grand irrigation scheme, provided we could command the heads of the rivers. I know of no others within my Circle worthy of a thought; the Poonpoon and other rivers in the zillahs of Patna and Behar are, as I have before said, dammed up for irrigation in many places; the Mahanuddy river, in Zillah Purneah, I believe, might be irrigated without any difficulty if irrigation would be a real advantage in such a country, but all these are somewhat large projects that require the undivided attention of an Officer.

5. But pending orders on the great Soane project, I would urge on Government the infinite good that must result if the existing Behar irrigation was placed under some competent man to organize and control it, and keep it from poisoning the inhabitants of the country more than is actually necessary; for, notwithstanding what may be said elsewhere on the "Philosophy of Stinks," no admirer of that theory can gainsay the unwholesomeness of the smells from noxious swamps.

Vide Saturday Review of January 1860, Nos. 1 and 2.

PART II.

THE MAGHASSANI HILLS,

AS A SANATARIUM.

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PAPERS

ON THE

MAGHASSANI HILLS.

No. I.

From G. F. COCKBURN, Esq., Superintendent of Tributary Mehals, Cuttack' to the Secretary to the Government of Bengal,—(No. 118, dated the 26th October 1858.)

SIR,—I have the honor to submit for the information of the Hon'ble the Lieutenant-Governor, a Memorandum of all that is known in this Office on the subject of the Mylagiri and Maghassani Hills, in the Tributary Mehals, and to solicit the issue of orders for an examination of the capabilities of the latter as a Sanatarium, and of the practicability of constructing a road to it from Balasore.

2. I beg to suggest that the Officiating Civil Assistant Surgeon of Balasore be directed to accompany Lieutenant Depree, Assistant Surveyor General, who will proceed during the month of December into Mohurbhunge for the purpose of Surveying that part of the country, and will visit the Hill about the latter end of it; these Officers would probably be of mutual assistance to each other, at least for such time as the Survey party were on the Hill.

3. This visit should be a preliminary one, and probably need not occupy above two or three weeks at the most, though it would be desirable to allow the Officiating Civil Assistant Surgeon to exercise a discretion as to the period of his stay.

4. It will be of greater importance to have more complete investigation made at a somewhat later period of the season towards the end

of February and in March, for if ever the Hill is to be used as a Sanatarium, its chief benefits will be obtained in the hotter months.

5. During the absence of the Officiating Civil Assistant Surgeon, the services at Balasore of the Sub-Assistant Surgeon of Bhudruck may be authorized, without much inconvenience to the latter Station.

6. For the purposes of reporting on the practicability of a road, the services of Mr. Mayne, C. E., Executive Engineer at Balasore may, I think, be available. A preliminary general examination of the country, and route, would suffice to be followed up hereafter, if necessary, by a more detailed one with attendant surveys.

7. Should this proposal be approved of, I beg that the necessary instructions may be communicated to the Officiating Chief Engineer.

8. The expenses of the expedition should not come to much, and will, I presume, be gladly sanctioned by Government; and it may be desirable to procure the loan of a Thermometer and other instruments from the Deputy Surveyor General.

Memorandum by G. F. COCKBURN, ESQ., Superintendent of the Tributary Mehals, Cuttack,—(dated 26th October 1858.)

IN the Annual Report on the administration of the Tributary Mehals for 1855-56, Mr. Samuells observed as follows:—

"There are in the Tributary Mehals two plateaux of considerable elevation which appear well fitted for Sanataria. The first is the Maghassani mountain, in Mohurbhunge, about 40 miles from Balasore, and the other Mylagiri in Palleyra. The latter was thoroughly examined during the past season by Captain Saxton, who has submitted a report on its capabilities to the Surveyor General; Maghassani is one of the grand Trigonometrical Stations, and has also been ascended by Captain Saxton, but he was so ill with fever while there, that he was unable to make any very detailed examination of the place. He and the Trigonometrical assistants however, assured me that there was a considerable plain covered with grass about 2 miles in extent, they seemed

to think, on the top of the hill or rather near the top, for the peak rises above the plain, and I have since been told that there is water in abundance on the sides of the hill, the height both of Maghassani and Mylagiri, is about 3,800 feet, and it is much to be desired that the route between Balasore and Maghassani should be carefully surveyed, and its capabilities as a Sanatarium reported upon by a competent officer, for Balasore it must be recollected is only 30 hours run for a Steamer from Calcutta. If the Survey were entrusted to Mr. Armstrong, the Civil Engineer in charge of the Balasore road, and the Medical inspection of the spot to Dr. Mantell, the Civil Surgeon of Balasore, I am confident the Government would receive reports on which they might safely rely."

Mylagiri Hill.

2. The Mylagiri Hill, in Palleyra, has been reported upon by Captain Saxton in the following words :—

"The country we have traversed this season is, in its physical condition, far more interesting and less formidable than I had anticipated. The Station of "Kumritar" is on a very extensive range, running north-east for some 14 miles, at the elevation of about 3,600 feet: to the west of this ridge is extensive table land at a little lower elevation, on which are villages, and well watered and cultivated land; one of the hill streams after running along a beautiful little valley, above which is prettily situated the village of "Jombarun Dehi," inhabited by Bahians (a hill tribe) falls over cliffs of red jasper. The waterfall is very beautiful, and I ascertained by observation below, that the abrupt fall is 550 feet. The little stream runs west for a few miles and then falls into the Bramini river. The country bounded by a line, running from "Kumritar" to 2 miles beyond "Gada Mardan," thence by "Goputh Gunga," and on south a little below "Kudu Takara," thence west, keeping a few miles above "Mylagiri," and round again to "Kumritar" is a mass of Hills and valleys, the former ranging about 2,000, and the latter about 1,400 feet. The sloped sides of these Hills are cultivated with rice, and there are many good villages. The roads wind about and seldom have abrupt ascents. The Baiturni River here takes its rise, making a considerable circuit by the north, before taking its south-easterly direction to the sea. The

inhabitants were as usual timid; by careful management and kind treatment we were more than usually successful in gaining their confidence, and on no occasion had we any difficulties arising from their shunning intercourse with us. The station of "Mylagiri" is on a fine Hill, 3,850 feet high, with plenty of good water near the top, and easy access might be made from the Southward. There is ample ground on the top for building and even garden purposes, and this might be made into a Sanatarium."

3. The distance of the Mylagiri Hill from the sea coast at Pooree is so great, about 121 miles N. E. as the crow flies, and the intervening country after leaving Cuttack is so covered with jungle and low hills, that there seems no present prospect of the establishment of a Sanatarium there being made much use of, even if practicable, there are no Civil or Military stations nearer to it than Cuttack, (76 miles direct) and the Residents of Cuttack would always prefer to seek change of climate on the sea coast, which is nearer and more convenient of access, and where the fresh breezes from the sea in the hot weather months must be more beneficial, while there is also the opportunity of getting away altogether in the event of further change being considered desirable or necessary.

4. In regard to the Maghassani Hill, in Mohurbhunge, the case is somewhat different; it is nearer the Coast, and can probably be made accessible.

5. The Lieutenant-Governor of Bengal on receipt of Mr. Samuells report referred to, expressed a desire* for further information regarding the Maghassani Hill, and stated that "enquiry would be made as to the practicability of employing Mr. Armstrong on a Survey of the route between Balasore and Maghassani, but even if his services should not be available for the purpose, the Magistrate of Balasore accompanied by the Medical Officer, might possibly visit the mountain for a few days in March or April next, and furnish an accurate report of its general features and capabilities, and of the temperature obtaining at the time of their visit."

* No. 855, dated 16th December 1856.

6. Difficulties arose in consequence of the services of the several officers referred to not being available, and nothing was done during the favorable season of 1856-57; while in the following year the mutinies having broken out, it was not thought proper to attempt an exploration of the Mohurbhunge territory.

7. The subject however has not been lost sight of, more especially as the Lieutenant-Governor again expressed his desire that it should be attended to, observing as follows:—

"Although the attempts made to investigate the capabilities of the Maghassani Mountain as a Sanatarium, have not yet been successful, the Lieutenant-Governor would regret to see such an important subject entirely dropped, and he has no doubt that you will lose no opportunity that may arise of carrying out his wishes regarding it."

8. Sanction will now be requested to the deputation during the ensuing season of the Officiating Civil Assistant Surgeon, and the Executive Engineer of Balasore.

9. The Maghassani Hill was visited by Captain Saxton, Assistant Surveyor General, when he was in such ill health as to be obliged to leave it almost immediately, and had neither time nor opportunity to make or to record any observations respecting the Hill.

10. The only information respecting it in this Office is contained in the following Memorandum furnished by Major Strange, Astronomical Assistant G. T. Survey of India, in charge Coast Series, and is dated the 23rd March 1857, he observes:—

"A Principal Station of the Coast Series Great Trigonometrical Survey of India, is fixed on the summit of the Hill of Maghassani. The position of the Station is as follows:—Latitude, North 21°-38' and Longitude East 86°-24'; its height above the mean Sea level is 3,821-53 feet. It is situated in the Mohurbhunge Estate, and is in a direct line, 38 miles from the Station of Balasore nearly due west.

"The only notice of the Hill existing in the records of the Coast Series Office, consists in a brief description of the Station appended

to the observation taken there. I regret that this having been left at Cuttack is not at present at hand, but from my recollection of its tenor, I do not believe it would throw much light on the question of the suitability of Maghassani for a Sanatarium.

"I have myself no personal knowledge of the Hill, that portion of the Coast Series having been completed before I received charge of the work. The following particulars have been obtained from men of the native Establishment, who visited the hill in the course of the operations.

"The two Ooryah villages of Pooradeea and Coomibrook, about half a mile apart, are about fifteen or sixteen miles from the Trigonometrical Station on the top of the Hill. These villages supplied the camp, which may have consisted of about (150) one hundred and fifty men, with provisions during its stay of a week. These are the nearest villages to the hill.

"The country round the Hill is covered with dense jungle, very thinly inhabited, and frequented by wild Elephants. The tract between Balasore and the hill is said to offer no difficulty to the construction of a road.

"The top of the Hill is open and generally flat. All agree that there is building space, but there are differences of opinion as to its extent, some men saying that there is room for many bungalows, others that 5 or 6 only could be built there. There is not much stone or wood on the top, but the sides yield an inexhaustible supply of these materials. Lime is procurable from the village of Pooradeea below; my informants are not aware if any is procurable on the Hill itself. There is plenty of grass fit for thatching on the Hill. A spring of excellent water, said to flow plentifully all the year round, exists near the summit of the Hill about one mile from the Trigonometrical Station, towards the north.

"The ascent was cleared sufficiently to enable the instruments and tents of the party to be carried up by men. It is said to have been

very gradual and easy, and to be susceptible of being rendered fit for laden bullocks without great expense.

"The Hill and surrounding jungles are thinly peopled by two races called Oojia and Bhoomeejee, who have no settled habitation, but roam about and live in caves and holes. They subsist chiefly by the sale of wild honey which is very plentiful, and of black Minahs, esteemed for their talking powers. They live on roots, wild fruits, and such animals as they can kill with their bows and arrows, with which implements all are armed. They are an inoffensive, honest, industrious race, very well disposed towards Europeans. It is estimated by my informants that (500) five hundred of these people could be collected in a few days if required. They eagerly accept employment at 1 anna a day.

"The party of the Coast Series was at Maghassani in the latter end of the month of February. It was then very cold on the Hill; a portion of the party was encamped on the Hill, and a portion below at Pooradeea. During their stay of a week, no sickness whatever occurred either above or below. Detached signal parties occupied the Hill at different times during the season; on one occasion one of these parties was there upwards of a month, but no one in any instance fell ill at Maghassani.

"I have not been able to find any register of the Thermometer taken at this Station."

11. In forwarding the above, Major Strange stated in a note to myself, "of course I have given no opinion as to the suitability of the Hill for a Sanatarium, but it strikes me that 3,821 feet is somewhat low for that purpose, surrounded as it is by Elephant jungle, there cannot but be malaria there, and I very much doubt whether such an elevation will be out of its influence. Mount Aboo, in Rajpootna, where I resided two or three years, is 4,000 feet in a higher latitude, and I imagine less jungly, yet fever was very prevalent there in the usual fever season of the year. The comparative proximity of the sea may, however, give Maghassani some advantage."

"I shall, I hope, visit this season one or two Hills immediately on the Coast, which from the accounts I have of them I expect to find higher than Maghassani. They lie south of Ganjam. I will take note of the temperature, &c., and shall be glad to collect any information in my power regarding them, if you can let me know what would be the chief points of interest; such information can do no harm, although there may be no immediate prospect of turning it to account."

12. It would be interesting to learn the result of Major Strange's observations respecting the two Hills he refers to; for if higher and nearer the sea coast than Maghassani, they will probably be better suited as Sanataria. He has left this part of the country, and the Hills in question are in the Madras Presidency, and so it is out of my power, and it would be out of place in me to prosecute enquiries in regard to them, though the matter may be one not undeserving the attention of Government.

13. I will only add that in November 1856, when there was a prospect of Maghassani being visited by T. N. Armstrong, Esquire, C. E. and Executive Officer, Cuttack road, I received a note from that very zealous and intelligent officer, of which the following is an extract:—

"With regard to the height of the plateaux at Maghassani (3,800 feet) being of sufficient elevation for a Sanatarium, I forgot to mention in my letter to you on this subject that, (as well as I now recollect) the theoretical Thermometer difference due for every 334 feet of vertical ascent is one degree of decrease, now 3,800 feet of vertical ascent ought to give 11 of decreased temperature over that of the sea, or rather of the level of the sea, but often the rate I mention is not obtained, and again *more* is found to be the case under favorable circumstances of location."

"3,800 feet ought to lift one up above the stratum of air heated by contact with the earth's surface; I have known the actual advantage of elevation much greater than the lowering of the temperature would lead you to suppose, arising from local breezes, aspect, &c."

14. Though the height of the Maghassani Hill is less than that generally supposed sufficient for a Sanatarium, yet the comparative proximity of the sea coast may favorably affect the climate, more especially during the hot months, when there is always a strong breeze blowing across the Bay of Bengal.

15. A letter has recently been published in the newspaper from the pen of the eminent Doctor Martin, who appears to be of opinion that a lesser height than that of our ordinary hill Stations would be better adapted for the European constitution, and he strongly recommends that search should be made for Hills of a medium height and examination of their capabilities for Sanataria, the importance of the subject, and his pertinent observations will justify the closing of this Memorandum with a copy of his letter.

THE HEALTH OF THE BRITISH TROOPS IN INDIA.

The following suggestions have been made by Dr. J. R. Martin to the Chairman of the Court of Directors:—

It is stated by Colonel Sir Alexander Tulloch, as the result of investigations in the War Office, made by the desire of Mr. Sidney Herbert, that among British officers and soldiers of the Queen's and Company's armies serving in the East Indies, there occurred, from 1815 to 1855 inclusive, a total mortality, exclusive of casualties, of about 100,000 men, "the greater portion of whose lives might have been saved had better localities been selected for military occupation in that country."

2. Doctor Burke, late Inspector-General of Hospitals in Bengal, has stated that in the Station of Secundrabad alone, during 30 years of its occupancy by British soldiers, the cost to the State on account of loss of life amounted to £150,000, estimating each soldier as worth £100. But estimating the loss of life mentioned by Sir A. Tulloch at the same valuation of £100 each man, we arrive at a loss in money of £10,000,000 sterling.

3. Then there has been enormous waste of the public funds on account of barracks and hospitals placed in Stations so unhealthy that they were subsequently abandoned. The buildings for the European troops at Berhampore, Bengal, abandoned since 1835, on account of its unhealthiness, are stated by the finance authorities of Calcutta to have cost since 1757, nearly £17,000,000 sterling.* Tennant declares that, up to this time, the sums expended by the East India Company for the accommodation of their European troops, "if laid out at the compound interest of the country, would at a determinate period not very remote, have equalled the national debt."

4. Looking to these enormous sums, often absolutely worse than wasted, of what account in the comparison has been the cost of the medical establishments of India? How truly saving of the public revenues must be a well-ordered and well-directed and a well-contented medical corps! In truth, the importance of an efficient medical establishment is so great that we cannot put a money value on it.

5. As regards the preservation of European health in India, and indeed, in all tropical climates, the due selection of locality is the first consideration; and next in importance stands the structural arrangements in barracks and hospitals.

6. As to barracks, provided the site be of sufficient elevation well cleared, drained, and levelled, with a good water supply, the material need not, I think, be of a costly character—well-constructed huts for the accommodation of 10 or 12 men forming a good protection against the inclemencies of weather. Such simple and cheap structures will, I believe, prove more conducive to the health of the European soldier in the mountain ranges of India than the most costly barrack; and the same may be said of hospital-huts for the reception of the same number of men, viz., 10 or 12. In Stations on the arid hot plains of India the same structures would answer well; but if large brick-built barracks and hospitals be preferred, they should be very spacious, double roofed, and raised on arches.

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* "Influence of Tropical Climates," page 424.

7. The considerations involved in the subject of the last paragraph are of the utmost importance, whether viewed in a sanitary or financial light; and the subject has hitherto been altogether neglected in locating troops in most of our foreign possession; although our experiences in all our European campaigns have demonstrated that the soldiers who were hutted fared well, while such as were massed in barracks and general hospitals perished at enormous rates.

8. This experience has been uniformly accordant whether the climate was hot or cold, whether our men were serving in Holland or in the Crimea.

9. The Irish sufferers from typhus during the famine, who were massed in workhouses and hospitals perished in enormous numbers, whereas those who were thrown along the roads and under the hedges recovered in goodly proportions; of so much more avail is pure air towards the restoration of health than a fine building. The thorough ventilation through the openings and crevices of huts supplies the sick with what they don't obtain in our ill-constructed barracks and hospitals—namely, pure air.

10. They were not palaces that were constructed by order of Sir Charles Metcalfe on the mountains of Jamaica; but a substantial form of hut, which, on a pure and elevated soil, was all that was required. Buildings such as those just referred to, constructed of the most ordinary materials, have been found to insure health, while Indian experiences prove that costliness of material and splendour of structure, apart from a good locality, will not prevent disease.

11. The importance of determining the true physical characters, and the exact medical topography of all the mountain ranges throughout India—especially of those situated in provinces in which it is desirable that British troops may reside—has now become imperative. European soldiers cannot maintain health or vigour in the plains, and the selection of suitable mountain Stations has become more than ever a State necessity.

12. The experiences of the Himalaya positions, of those of the Neilgherry mountains, and of those of Ceylon, as sanitary Stations, prove that by residence on their respective elevations the European is removed greatly above the range of the malarious fevers in India. But while this great and valuable fact is admitted, it is undoubtedly true that he is, in too many instances, carried into the range of another class of diseases—namely, that of bowel complaints. This circumstance has been found in various of our mountain positions to constitute a serious drawback from the otherwise great benefits derived from a residence in them.

13. Another disadvantage of the Hill Stations hitherto occupied by us in the East Indies was noticed by me when serving in Bengal—namely, that while the hill climates are permanently serviceable against the malarious fevers of the country, their influences in conducing to the cure of these and other diseases is limited in extent; the soldier being troubled with relapses of his disorders on descending into the plains, unless kept in the hills for a long time. The mountain ranges, therefore, which have hitherto been occupied by Europeans, stand forth as possessing climates preservative against fevers, and as such we must improve them, and use them wherever required.

14. When, on the other hand, we find the British soldier lingering under chronic or structural diseases contracted on the plains, a removal to the sea board, or to an insular sanitarium, or, still better, to England, will be found the only effective means of restoration; and this last resource of medicine should never be denied to him, for the climate of the mountains, invaluable in prevention, will not cure disease.

15. Referring to what has been stated in paragragh 12, how are we to escape from the admitted evils hitherto experienced in the very high positions occupied by us? Where and how are we to obtain that amount of elevation which, while it removes the European out of the range of malarious fevers, may not place him in that of an exhausting and dangerous diarrhœa? This is the great desideratum—one hitherto unascertained because unsought for; yet no examinations

which may fall short of ascertaining this desired medium elevation can be deemed satisfactory of our sanitary want.

16. In the climates of yellow fever an elevation of 2,500 feet is found sufficient to remove the European from the locality of pestilence, without placing him in that of bowel disorders; and in the mountain stations of Jamaica the mortality among British soldiers is found to exceed but little, if at all, that of the same class of men in the United Kingdom.

17. Let us then, have a series of careful and scientific examinations, by competent persons, of the lower and medium ranges of Hills throughout India, in order that the great Sanitary problem may be solved in a conclusive manner—namely, the providing a place of resort for our European troops which shall be alike free from malarious fevers and from disorders of the bowels. That such procurable localities are to be found in the East, as they have been in the West, is my firm belief, and let them be perseveringly sought for.

18. Let the solitary Hills—those islands on the plains—be sought for, and carefully examined; they give sanitary excellences peculiar to themselves.

Lastly, let there be appointed for the sanitary duties of the army, at each of the Indian presidencies, a medical officer of health—an officer of scientific attainments and of rank, who shall be attached to the Quarter-Master General's department—we shall thus add to the department of military topography that of medical topography. The medical officer of health should preserve in his office for the use of the scientific persons concerned, plans and models of the best barracks and hospitals which may be, from time to time, approved by the military powers of Europe, in order that the most recent improvements may be rendered available wherever buildings of the nature indicated may be found necessary.

The duties of the medical officer of health should be, in peace, to examine and report on all sites and on the condition of camps, temporary military stations and cantonments, on convalescent stations and

sanataria, on mountain ranges suitable for troops, and on solitary mountains and their capabilities, on the plains and structure of barracks and hospitals, and on everything relating to the health and comfort of the soldier.

In war he should be attached to the Quarter-Master General in the field, and be always in advance with this officer, so as to master the medical topography of the scene of action; and, where military reasons of imperative necessity do not overrule sanitary considerations, the advice and opinion of the medical officer of health should be received on the sites of camps, whether temporary or permanent, and on all matters having reference to the sanitary condition of the camp.

In a recent report to her Majesty by a royal commission, of which I was a member, and which was ordered to inquire into the organisation, government, and direction of the medical department of the British army, the appointment of a medical officer of health, as long previously recommended by me for the service of the Indian army, was strongly urged upon her Majesty's attention, with a view to the great benefits to be expected from the services of such an officer.

Grosvenor-street, London, August 12, 1857.—*Home News, September* 17.

No. II.

From C. T. BUCKLAND, ESQ., Junior Secretary to the Government of Bengal, to the Superintendent of Tributary Mehals, in Cuttack,—(No. 3528, dated Fort William, the 18th November 1858.)

SIR,—I am directed to acknowledge the receipt of your letter No. 118, of the 26th ultimo, submitting a Memorandum relative to the Mylagiri and Maghassani Hills in the Tributary Mehals, and offering certain suggestions for the examination of the latter Hill with regard to its capabilities as a Sanatarium, as well as of the country in the direction of Balasore, with a view to the construction of a road to it from that place.

2. In reply I am directed to inform you, that the Lieutenant-Governor is favorably inclined towards your proposals; but, before giving his authority to them, His Honor is desirous, under the present restrictions on public expenditure, that some information should be placed before him as regards the probable cost of carrying them into effect.

No. III.

From G. F. COCKBURN, ESQ., Superintendent of Tributary Mehals, Cuttack, to the Secretary to the Government of Bengal,—(No. 139½, dated the 4th December 1858.)

SIR,—In reply to Mr. Junior Secretary Buckland's letter No. 3528, dated the 18th ultimo, I have the honor to state, that on a rough calculation the expences attendant on the proposed examination of the Maghassani Hill are not likely to exceed Rupees 500, *viz.* personal travelling expenses to Dr. Kendall, at five rupees a day, for six weeks or forty-two days, ... 210 0 0

Extras on account of miscellaneous charges, ... 40 0 0

250 0 0

and a similar sum for the Executive Engineer, or 500 Rupees in all.

2. An account would be rendered to me, and only the actual expenditure charged for: it would probably be less than the sum I have stated, as there might not be occasion for so prolonged a stay on the Hill.

No. IV.

From C. T. BUCKLAND, ESQ., Junior Secretary to the Government of Bengal, to the Superintendent of Tributary Mehals, Cuttack,—(No. 28, dated the 5th January 1859.)

SIR,—I am directed to acknowledge the receipt of your letter No. 139½, dated the 4th ultimo, and in reply to inform you, that the Lieutenant-Governor is pleased to sanction an expenditure not exceeding Rs. (500), five hundred, for the travelling and other expenses attendant on the proposed examination of the Maghassani Hill, by Dr. Kendall, and Mr. Mayne, the Executive Engineer, if he can be spared from his proper duties, with a view to ascertain its capabilities as a Sanatarium.

2. The bill may be passed by you, in communication with the Accountant to the Government of Bengal, up to the amount specified as a special case, and adjusted as that Officer may direct.

No. V.

From G. F. COCKBURN, ESQ., Superintendent of Tributary Mehals, Cuttack, to the Secretary to the Government of Bengal,—(No. 196, dated the 14th February 1859.)

SIR,—Referring to Mr. Junior Secretary Buckland's letter No. 28, dated the 5th ultimo, I have the honor to submit, in original, the accompanying Report from Dr. Kendall, Officiating Civil Assistant Surgeon of Balasore, on the Maghassani Hill.

2. The services of Mr. Mayne, Executive Engineer, were not available, but this is the less to be regretted, as Dr. Kendall's Report is sufficiently favorable in respect to the practicability of constructing a road to the top of the Hill.

3. The Report now submitted appears so far to be very satisfactory, but it will be necessary, in my opinion, that the Hill should be revisited in the month of March or April, and I have requested Dr. Kendall to arrange for doing so.

4. I have also requested V. H. Schalch, Esq., the Magistrate of Balasore, and Assistant Superintendent in the Tributary Mehals, who is an excellent Mofussil road-maker, to accompany Dr. Kendall, if his other duties allow of doing so.

5. I venture to suggest for the consideration of the Lieutenant-Governor, that copies of Dr. Kendall's Report be given to some Medical authorities or other persons, now in Calcutta, acquainted with Hill Stations and their requirements, in order that suggestions may be invited in regard to particular points on which information would be valuable, or to which the attention of Dr. Kendall, and Mr. Schalch, may be usefully directed.

6. No time, however, should be lost, as the second expedition will be made about four weeks from this date.

7. I have not retained a copy of the Report, and beg that three may be sent me when printed, one for my own Office, and one for that of the Magistrate of Balasore, and a third in case of being required.

Report by Dr. Bernard Kendall on the "Maghassani" Hill, situated in the Territory of the Rajah of Moharbhunj, in Latitude 21° 38° North and Longitude 86° 24° East. Height above the mean Sea level 3,821 feet as given by Major Strange, and distant from the Port of Balasore about 40 miles in a direct line.

1*st.* For the first few miles after leaving Balasore there is a good kutcha road, but this ceases at the village of Rewnah (about eight miles from Balasore) and from thence to the foot of the Hills, there is only a tract or path practicable for bullocks or doolies only; this path leads through dense jungle, except at intervals where villages exist, and the ground for some distance around them is cultivated. The country is chiefly level or only slightly undulating, and along the path, I continually saw the ferruginous gravel used in this Station, and at Midnapore, for metalling roads, as well as beds of "Kunker" or lime-stone. There are only one or two small streams to be crossed, and these at this season are nearly dry.

2*nd.* In ascending, we first crossed a low range and then again ascending, reached a large plateaux of many miles in extent, and crossing this for two or three miles, we came to a stream of running water, and we encamped for the day in an open spot close by. I found afterwards that this stream joins a larger one to the east, a little below the place of our encampment. Early the next morning we again set out, and after traversing the plateaux to the foot of the Maghassani, (a distance of two or three miles) we again commenced ascending and had to wind around the Hill, so as to reach the summit from its north-western aspect, it being precipitous on its south-eastern side.

3*rd.* The summit of the Maghassani on which the platform is built is of small extent, very rocky and not well suited for building purposes, but it slopes gradually down to the valleys beneath on its north-western aspect, and on this slope there is plenty of room for building.

4th. To the north-east of the platform, and distant as the crow flies from half a mile to a mile, are several peaks and ridges on which capital building sites are available; one peak especially deserves notice, it being on the same level as the platform, and having an extensive area on its summit quite clear of trees or jungle, and free from rocks; small boulders only being scattered here and there, the slope from this is gradual on every side, and it commands an extensive view.

5th. The soil seems originally to have been a rich but light marl, but as you descend into the valleys, it loses this character from the large quantity of vegetable mould which has accumulated. I should think that all vegetable products would thrive most luxuriantly, the soil being rich and well suited to their culture, and there being great variety of aspect.

6th. I found several small streams of water in the valleys beneath; the nearest stream being rather more than a quarter of a mile distant from the summit of the Hill. The water was clear and limpid, very soft and sweet, but not having the necessary re-agents, I am unable to give a chemical analysis of it.

7th. The climate was cool and bracing, the mornings and evenings together with the nights, being very cold during the time I was on the Hill; there was a constant breeze from the north, and I spent the greater part of each day in examining the topography of the district, and during this time I did not feel oppressed either by the heat or sun's rays, although taking a great deal of exercise to which I was unaccustomed, and this at all hours of the day. After sunset we had always a large fire within a few yards of the tent, which was kept burning during the night, as well as the numerous fires of the camp-followers all around us; our tent also was pitched in a sheltered spot not far from the water, so that I am inclined to think the Thermometer would have been one or two degrees lower at the summit where it would have been out of the range of the influences mentioned. The lowest marked by the Thermometer on the Maghassani was 44 degrees at 7 A. M., on the 22nd January, and the highest during the day was 73 degrees, and at

4 P. M. on the same day it was 58 degrees. During the time I stayed there it only varied one or two degrees from the above.

The extreme range of the Thermometer during the day was 29 degrees.

From my inspection of Maghassani I have arrived at the following conclusions:—

That it is most easy to construct a road to the foot of the Hills, a portion of it being already made.

That the ascent is gradual, and that a road practicable for riding might be made at moderate expense from the base to the summit.

That all along the line, materials exist for metalling the road, if it should be found desirable.

That on the summit occur peaks and ridges with gradual slopes, with great variety of aspect, well calculated for building sites in almost any number.

That there is good and pure water arising from springs near the summit, and which according to native accounts, continue to flow all the year.

That the soil is rich, and calculated to produce all kinds of vegetables and fruits in great abundance.

That a few hundred feet below the summit of the Hill, is a large plateaux of several miles in extent, well watered and covered with large forest trees. The soil of this plateaux being a rich marl, it is suited to a great variety of products, and could be made to supply the Station above with nearly every requisite.

That all the materials necessary for building purposes are to be found both on the Hill and on the plateaux, viz, stone, wood of superior

quality, Kunker or lime-stone, earth for brick-making, and grass for thatching.

That if a road existed, it would only take about three days to reach it from Calcutta, viz. by Steamer to port of Balasore 24 hours, from thence to foot of Hill 12 hours, and from thence to the summit 6 hours.

That the climate is agreeable and very considerably colder than the plains, there being a difference of 19 to 20 degrees between observations taken at the same time on the Maghassani and at the station of Balasore.

That it would be desirable to visit the Hill again in the month of March, for the purpose of making more extended observations of its temperature during the hot weather.

That being only 38 to 40 miles from the sea (as the crow flies) and being also the highest mountain in the range, it is likely to have advantages peculiar to itself; and it is open to every breeze that blows whether from the Bay of Bengal, or from other quarters.

In conclusion, I beg to make the following quotations from Dr. J. R. Martin's letter to the *Times*, in August 1857 :—

" Where and how are we to obtain that amount of elevation, which while it removes the European out of the range of malarious fevers, may not place him in that of an exhausting and dangerous diarrhœa? This is the great desideratum, one hitherto unascertained, because unsought for; yet no examination which may fall short of ascertaining this desired medium elevation, can be deemed satisfactory of our sanitary wants.

" In the climates of yellow fever, an elevation of 2,500 feet is found sufficient to remove the European from the locality of pestilence, without placing him in that of bowel disorders; and in the mountain stations of Jamaica, the mortality among British soldiers is found to exceed but little, if at all, that of the same class of men in the United Kingdom.

" Let us then have a series of careful and scientific examinations by competent persons of the lower and medium ranges of Hills through-

out India, in order that the great sanitary problem may be solved in a conclusive manner, namely, the providing a place of resort for our European troops which shall be alike free from malarious fevers, and from disorders of the bowels. That such procurable localities are to be found in the east as they have been in the west, is my firm belief, and let them be perseveringly sought for.

"Let the solitary hills—those Islands on the plains—be sought for and carefully examined; they give sanitary excellences peculiar to themselves."

No: VI.

From C. T. BUCKLAND, ESQ., Junior Secretary to the Government of Bengal, to the Superintendent of Tributary Mehals, Cuttack,—(No. 769, dated the 28th February 1859.)

SIR,—I am directed by the Lieutenant-Governor to acknowledge the receipt ef your letter No. 196, dated the 14th instant, with its enclosure, and in reply to request that you will convey to Dr. Kendall His Honor's thanks for his interesting account of his expedition to the Maghassani Hill, the description of which appears to the Lieutenant-Governor to be sufficiently promising to render it desirable that another visit should be paid to the Hill as proposed by you.

2. The Lieutenant-Governor approves therefore of your having requested Dr. Kendall to arrange for a second expedition; but His Honor is of opinion that the middle of March will be too early a date for it, and that it will be better to defer it until April or May, in order that the climate, &c. of the Hill may be observed during the driest and hottest season of the year.

3. Enclosed are the three printed copies of Dr. Kendall's Report required by you.

4. A copy of the Report will be forwarded to each of the Calcutta Newspapers for publication.

No. VII.

From G. F. COCKBURN, ESQ., Commissioner of Circuit, Cuttack Division, to the Secretary to the Government of Bengal,—(No. 215, dated the 7th March 1859.)

SIR,—the Magistrate of Balasore reports that the instruments noted in the margin, are required by Dr. Kendall, Civil Assistant Surgeon, who is about to revisit, towards the end of this month, or early in April, the Maghassini Hill, and I have the honor to request that the necessary orders for their immediate despatch, direct to the Magistrate of Balasore, may be given at once, in order that they may be received in time to be of use.

A good Thermometer.
A wet bulb Thermometer of corresponding scale.
A self-registering maximum and minimum Thermometer.

2. The Magistrate, V. H. Schalch, Esq., proposes to join Dr. Kendall for 1 week of the 2 or 3, that the latter hopes to remain on the Hill.

3. It is arranged to leave a small party behind to carry on the observations of temperature, &c. to the close of the season.

No. VIII.

From E. H. LUSHINGTON, ESQ., Officiating Junior Secretary to the Government of Bengal, to the Superintendent of the Mathematical Instrument Maker's Department,—(No. 833, dated the 14th March 1859.)

SIR,—I am directed by the Lieutenant-Governor to request that you will take measures to forward, with the least possible delay, to the Magistrate of Balasore direct, the Instruments specified in the margin, required for the use of Dr. Kendall, who is about to revisit the Maghassini Hill towards the end of this month or early in April next.

A good Thermometer.
A wet bulb Thermometer of corresponding scale.
A self-registering maximum and minimum Thermometer.

No. 834.

Copy of the above Letter forwarded to the Commissioner of the Cuttack Division, with reference to his Letter, No. 215, dated the 7th Instant.

No. IX.

From MAJOR H. L. THUILLIER, Superintendent Mathematical Instrument Department, to C. T. BUCKLAND, ESQ., Junior Secretary to the Government of Bengal,—(No. 88, dated the 22nd March 1859.)

SIR,—In full compliance with orders contained in your letter No. 833, dated the 14th instant, I have the honor to state, for the information of Government, that the Instruments required for the use of Dr. Kendall, Civil Surgeon, Balasore, have been despatched to the address of that Officer by special Cossid bearer on the 16th idem.

No. 1157.

Copy of the above Letter forwarded for the information of the Commissioner of the Cuttack Division, in continuation of No. 834 of 14th instant.

By Order of the Lieutenant-Governor of Bengal.

FORT WILLIAM,
The 26th March 1859.

(Sd.) E. H. LUSHINGTON,
Offg. Jr. Secy., to the Govt. of Bengal.

No. X.

From G. F. COCKBURN, ESQ., Superintendent of Tributary Mehals, Cuttack, to the Secretary to the Government of Bengal,—(No. 37, dated the 18th June 1859.)

SIR,—Referring to Mr. Junior Secretary Buckland's letter No. 769, dated 28th February last, I have the honor to submit, in original, letters as per margin, from the Magistrate of Balasore, V. H. Schalch, Esq., and the Officiating Civil Assistant Surgeon, Dr. Kendall, furnishing further Report on the Maghassani Hill.

Magistrate's No. 86, dated 4th June.
Officiating Civil Assistant Surgeon, without number or date.

2. Mr. Schalch proposes that a small party of Sappers and Miners with a Sub-Assistant Surgeon in medical charge, be sent next cold season to clear one of the higher ranges, construct a log house for themselves, and cultivate the adjoining lands in order that further experience may be obtained in regard to the suitability of the Hills for colonization or as a Depôt for Troops.

3. I apprehend that by publishing these Reports, and thus giving all the information in the possession of Government to the public, it may be left to private enterprize to engage on any agricultural schemes that may seem to offer advantages, while the accounts already received are not sufficiently encouraging to warrant the establishment of any Depôt for Troops.

P. S.—I solicit the favor of your sending me three copies of the enclosures should they be printed.

From V. H. SCHALCH, ESQ., Magistrate of Balasore, to the Commissioner of the Cuttack Division,—(No. 86, dated the 14th June 1859.)

SIR,—I have the honor to forward a further Report from the Officiating Civil Assistant Surgeon on the Maghassani Hill.

2. I arranged to meet Dr. Kendall on the Hill during the first week in April, and remained there 3 days as my duties at the Station would not admit of a longer absence.

3. The first of the ranges of Hills of which Maghassani is the highest, is situated in the Mohurbhunge territory about forty miles directly west of Balasore, the road passing for half that distance through cultivated lands, and for the remainder through jungles. There would be no peculiar difficulty in constructing a road to the village of Poorhadeha, which lies close to the foot of the range; an average height of two feet would I think be sufficient, whilst a few bridges would be required over some half dozen hill streams, which are dry during the greater part of the year.

4. From Poorhadeha to Maghassani, a distance of about twelve miles, there exists at present only the pathway cut by the Surveyors, who have lately visited these Hills. The path follows nearly a direct course crossing in the first five miles four or five Hills which it boldly surmounts instead of gradually winding round their flanks. The last of these Hills rises nearly 3,000 feet above the level of the sea, and thence the road after descending a gentle declivity, winds over and round a more level series of smaller hills for a distance of another four or five miles, when it again abruptly ascends the Maghassani Hill to an extreme elevation of about 3,700 feet.

5. From the few glances I could obtain of the surrounding country when travelling over these hills, I am of opinion, that a cart road could be constructed without much difficulty by gradually ascending the shoulders of the several hills, increasing the total distance to probably fourteen or sixteen miles.

6. The hills for the first four or five miles consist of rocks uncovered with soil or low vegetation; but abounding in trees of various descriptions, averaging from four to six feet in girth. On ascending the last of these hills, the country changes its aspect, becoming a succession of rounded hills averaging about 100 feet in height, covered with rich vegetable mould free from underwood, but producing small

shrubs and bulbous plants, while the timber is of a finer and larger growth. These hills rise with so gradual a slope as to admit of easy cultivation, while their drainage must be rapid.

7. From this tract of country, which appears at first sight one plateau extending for miles on every side, rises the Maghassani hills as well as two other ranges of almost equal altitude. The Maghassani Hill itself ascends too abruptly to admit of much building ground, but the other ranges would each afford a space about quarter of a mile wide by one long, amply sufficient for the construction of Barracks and for parade ground for troops.

8. At the foot of these hills are springs, though their supply of water at the time of our visit was not very great, yet it increased considerably on their being cleaned, and I doubt not that a sufficient supply could be obtained by the construction of reservoirs, for which the materials would be at hand.

9. I found the climate most pleasant during the morning and evening and though the heat became somewhat oppressive for about two hours or from twelve to two P. M., yet it must be remembered, that we were in a small thin Tent unprotected by shade, and unfavorably situated on the side of the Hill, from whose bleak rocks the heat was refracted and reflected. Neither the Doctor nor myself suffered from any attack of fever, but most of our servants, who were of course more exposed, were attacked on their return. I should mention however, that fever has been most unusually prevalent this year throughout the District, and it is possible that their illness may have been unconnected with their visit to the Hill.

10. However this may be, I doubt not, that were the higher ranges cleared and cultivated, fever would not prove a prevalent disease.

11. The average temperature may be considered, as far as we can judge from our limited data, as certainly at least twelve degrees below that of our plains and of Bengal.

12. This temperature though not sufficiently low to render these hills useful as a Sanatarium for invalids, would probably render them available either for a depôt for Troops or for colonization.

13. In the former case, recruits from England would be saved from the numerous dangers which threaten their health when located in Calcutta, and whilst becoming acclimatized, would still be within easy reach of the city whither they could be conveyed within forty eight hours, were a Road constructed and a Steamer waiting for them at the mouth of the Balasore River.

14. For colonization there would be a very considerable extent of ground, judging from the Report of the surveyors who have traversed the whole length of these ranges, there would appear to be a tract of country some forty miles in length, by ten or twelve in breadth, of a similar description to the portion we visited, and which I should think admirably adapted to the production of coffee, wheat, potatoes and other vegetables, all of which would find a ready and accessible market in Calcutta. I believe that besides the above, the tea plant and the vine might be successfully cultivated.

15. Our knowledge of these Hills and their climate and capabilities, is too limited to warrant much reliance being placed on any supposition we can now arrive at.

There are however fair grounds for believing, that these hills might be rendered available for the purposes above mentioned, and I would propose that a party of Sappers and Miners attended by an intelligent Sub-Assistant Surgeon, be employed from the commencement of the cold season, to clear one of the higher ranges; construct a log house for themselves, and cultivate the adjoining lands. A year's experience of the result of the season and of their cultivation will furnish ample data on which to form a definite opinion of the suitability of these hills, whether for colonization or as depôt for Troops.

From BERNARD KENDALL, ESQ., Officiating Civil Assistant Surgeon, Balasore, to F. COCKBURN, Esq., Commissioner, Cuttack.

SIR,—I HAVE the honor to inform you, that in accordance with your instructions, received through V. H. Schalch, Esq., I left this

Station on the 2nd April for the Maghassani Hill, in order to make the observations required on its temperature, &c.

I was somewhat delayed at the foot of the hill, finding that the Chaprassies I had sent on some days previously, had not been able to get Coolies, to convey the tents, &c. up the hill; in consequence of Mr. King, Assistant Surveyor, who was at that time on the hill, having engaged all the available Coolie labor.

The climate was very pleasant in the mornings and evenings, but was rather hot during the day, the thermometer on one occasion being as high as 86·5 degrees; but as the observations were taken in a small tent, they are no doubt much higher than they would be, if taken in a proper place, and on that account, scarcely afford a fair comparison with those taken at other Stations.

From the 7th to the 14th April, thunder-storms occurred daily, generally coming on between 4 P. M. and 8 P. M., and during this time 9·9 inches of rain fell, the greatest quantity at one time being on the 12th, when 5 inches fell in about three hours; after the 14th there were very slight showers now and then of an evening, but never of sufficient quantity to guage.

With the exception of the thunder-storms above noticed, the days were fine and free from fog; the air being often remarkably clear after rain.

There was generally a good breeze blowing in the morning from the North and North-West; whilst in the afternoon it generally blew from the South and South-West.

From the annexed Table it will be seen that the mean temperature on the Maghassani, is 13·2 degrees lower than that of Calcutta, and 13·66 degrees hotter than that of Ootacamund in the Neilgherries, during the same month; so that it holds as it were a medium position, with regard to temperature, between these two Stations.

The following Table will show the difference of temperature at Balasore and the Maghassani, taken at the same hours and on the same

days, but the observations at Balasore were taken in a pucka building, whilst those on the Maghassani, were taken in a tent.

STATION.	6 A. M.	10 A. M.	4 P. M.	Mean.	Rain guage in inches.	REMARKS.
Balasore ...	7·9·8	81·6	84·8	82·06	3·7	Thermometric observations taken in pucka building.
Maghassani ...	69 3	77·3	77·9	74·83	9·9	Ditto ditto in tent.

The Maghassani range of hills as far as I have been able to judge, correspond very nearly to the Neilgherries as to formation and soil.

The supply of water near the summit of the Maghassani was, during the present visit, limited to a few springs; these however on being cleared out to the depth of from nine to twelve inches, gave a plentiful supply of beautifully clear water.

The Native left on the hill by me to continue the observations was attacked by fever a few days after I left, and obliged to come in; his illness, together with the great sickness that has recently occurred in Balasore, has caused the delay that has occurred in sending you this Report. I should also mention that two or three of my servants have been attacked with fever since their arrival in Balasore, but whether they contracted it on the hill, which is within the generally accepted fever range, or more probably caught it whilst remaining at Poorhadeha at the foot of the hills, I am unable to say.

From the experience gained during my visits, I am inclined to believe that the hill is more suitable as a Station or Depôt for Troops, than as a Sanatarium for Invalids.

It appears to be admirably suited, both by soil and climate, for coffee plantations.

A Table showing the Mean Temperature of the air during the month of April, at Calcutta, Bombay, Madras and Ootacamund on the Neilgherries, as given in "Smoult's edition of Dr. Baikie's" Work, also the Mean Temperature of the air on the Maghassani from recent observations.

Calcutta.			Bombay.			Madras.			Ootacamund 7,416 feet above sea level.				Maghassani.			
						From observations taken at the Observatory.			Mean average derived from observations taken by Dr. Baikie and Mr. Ross, extending over a period of 7 years.				From observations taken by Assistant Surgeon Kendall, extending over a period of 14 days.			
Mean Maximum.	Mean Minimum.	Mean Temperature.	Mean Maximum.	Mean Minimum.	Mean Temperature.	Mean Maximum.	Mean Minimum.	Mean Temperature.	Mean Maximum.	Mean Minimum.	Mean daily range.	Mean Temperature.	Mean Maximum by self registering Thermometer.	Mean Minimum by self registering Thermometer.	Mean daily range.	Mean Temperature.
3 p. m.	6 a. m.		4 p. m.	11 a, m.												
95·1	79·1	87·1	84.	83.	83·	92.	84.	89·4	68·66	51·82	16·84	60·24	82·3	65·5	20·28	73·9

B. KENDALL.

Officiating Civil Assistant Surgeon, Balasore.

Meteorological Register kept in a small Tent on the Maghassani Hill for the month of April 1859.

1*st May* 1859.

Latitude 21·38 *North. Longitude* 86·24 *East. Height above the Sea* 3,820 *feet.*

Days of the month.	AT SUN RISE.				AT 10 A. M.				AT 4 P. M.				AT 10 P. M.					Self Registering Thermometer.			Days of the month.
	Barometer.	Temperature. Of Mercury.	Of the Air.	Of wet bulb.	Direction of the Wind.	Barometer.	Temperature. Of Mercury.	Of the Air.	Of wet bulb.	Direction of the Wind.	Barometer.	Temperature. Of Mercury.	Of the Air.	Of wet bulb.	Direction of the Wind.	Barometer.	Temperature. Of Mercury.	Of the Air.	Of wet bulb.	Direction of the Wind.	Thermometer in sun's rays at 4 p. m.	Maximum.	Minimum.	Rain Gauge.	
	Inches.	0	0	0		Inches.	0	0	0		Inches,	0	0	0		Inches.	0	0	0					Inches.	
1st																									1st
2nd																									2nd
3rd																									3rd
4th																									4th
5th																									5th
6th																									6th
7th			72		N.			85		N.			85		N. W.										7th
8th			74		N. W.			85		S. W.			70		N. W.										8th
9th			70	63	N.			84	67	N.			82	73·5	N.						90	86·5	67	·2	9th
10th			68	62	N. by W.			78	67	N. by W.			84·5	72·5	S. W.						110	85·	62	·1	10th
11th			67	58	S. E.			77·5	70·5	S. E.			76	72	S. E.						106	79·5	62	·5	11th
12th			64	58·5	N.			78	67	N. by W.	25·950		79·5	70·5	N. W.						109	80	60	5·	12th
13th	25·950		64	59		26·050		63	59	N. W.	25·950		74	66	S. W.						93	78	59	·2	13th
14th	25·950		67	62·5	N.	26·050		80·5	67	N. W.	25·975		80	72·5	N. W.						112	81	60	3·	14th
15th	25·975		66	61	N. W.	26·075		77	66	N. W.	25·975		80	71	S. W.						110	81	59		15th
16th	26·025		73	68	N. W.	26·125		82	75	N.	26·000		77	71	N.							83	67		16th
17th	25·925		65	63	N. W.	26·000		69	64	N.	25·925		71	64	S.							80	65		17th
18th	25·909		71	66	W.	25·975		74	71	N.	25·900		77	71	N.							82	69		18th
19th	25·900		71	66	W.	25·975		74	71	S.	25·900		77	71	S.							84	72		19th
20th	25·925		73	65	W.	26.000		78	71	N.	25·925		78	71	S.							84	71		20th
21st	25·900		74	66	N.	26·000		74	71	N.	25·925		77	71	S.							84	73		21st
22nd	25·875		71	68	S.	26·025		78	72	N.	25·825		79	70	S.							85	71		22nd

B. KENDALL,

Officiating Civil Assistant Surgeon, Balasore.

No. XI.

From E. H. LUSHINGTON, Esq., Officiating Secretary to the Government of Bengal, to the Superintendent of Tributary Mehals, Cuttack,—(No. 3359, dated Fort William the 21st September 1859.)

SIR,—I AM directed to acknowledge the receipt of your letter No. 37 of the 18th June last, submitting, with reference to the Orders of the 28th February last, a further account of the Maghassani hill by Dr. Kendall, the Officiating Civil Assistant Surgeon of Balasore, and by the Magistrate, Mr. Schalch, who accompanied Dr. Kendall on his second expedition.

2. In reply, I am directed to state that the Reports of both these Gentlemen are very interesting, but that on the whole the Lieutenant-Governor agrees with you in considering that they are not sufficiently encouraging to warrant the establishment of any Military Depôt on the hill.

3. With Parisnauth hill 800 feet higher, much more easily accessible and free from all suspicion of feverishness, which cannot by any means be said of the Maghassani hill from what little experience has been obtained regarding it, the Lieutenant-Governor is of opinion that it would be only waste of money to attempt to do anything further at present on the Maghassani, with a view to the formation upon it of a Depôt for European troops.

4. The hill may, however, His Honor remarks, eventually be found worthy of attention on account of its suitability for the cultivation of Coffee, &c.

5. Three printed copies of both the Reports under acknowledgment are herewith forwarded to you as requested, and I am directed to mention that copies will also be sent to the local newspapers for publication.

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